Experiential Metaphors: Create Anti-negative Home Products

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Experiential Metaphors:
Create Anti-negative Home Products

by

Hong Ying Guo

A Thesis Submitted in Partial Fulfillment of the Requirements for
the Degree of Master of Fine Art in Industrial Design

School of Design / College of Imaging Arts and Sciences

Rochester Institute of Technology
Rochester, NY
September 21, 2015
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Abstract

Experiential metaphor is a user-centered design approach and methodology that I developed for my thesis project. This approach can be applied to a design to influence a user's perception or design process to facilitate the designer's concept ideation. The intention of this approach is to create a pleasurable product experience and a positive emotional response through interaction with the product and interpretation of its meaning. Grounded in meaning association, which is correlated with non-linguistic cognitive metaphor and human emotional models, four different levels of experiential metaphor are formed by the synthesis of the metaphor structure and levels of emotional elicitation. The design of these two application projects demonstrate the value of experiential metaphor in successful design. Meanwhile, the challenges and limitation are discovered and can be a useful reference to design methodology execution.
Thesis Committee Approval

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PART1: THEORY FOUNDATION AND HYPOTHESES

1. INTRODUCTION

1.1 Thesis Purpose

Beyond form and function: the meaning of products

For emotional design, the human-centered concern is not only based on conventional human factors but also the meaningfulness of artifacts to users, or, what they mean to users and what meanings users care about. I would like to quote a description of James J. Gibson’s (1979) opinion from “Product Experience,” edited by Hendrik N.J. Schifferstein & Paul Hekkert (2008) about the meaning of interfaces to users:

We perceive not things, but what they afford us to do., …it would be a categorical mistake to describe the physicality separate from how we perceive and act on them, ...we cannot perceive what something IS, but what we can do with it or how it can affect us. Considering artifacts as bundles of affordances means describing them –…not in terms of quantitative measurements, say, of the diameter of handles, but in terms of their "gripability"; not in terms of efficiency (measured in gain over effort), but in terms of whether they aid our sense of success; not in terms of whether something IS beautiful, but in terms of the fascination and excitement they trigger in us; not in terms of user-friendliness as an objective property, but in terms of how comfortable we are in handling them without fear of failures. The suffix "-able" always refers to what factors can do, not to physical properties (2008, p360).

Apparently, in some cases, when designers execute the design application followed by the primary method, the "formal properties"(can be objectively measured) are usually thought to outweigh the "experiential properties" (subjectively experienced by users) (Patrick Jordan 2002). Therefore, confusion occurs between execution of the method and expectation of the application. For instance, the electric citrus juicer with a powerful motor and stable base is intended to make sure the machine will perform efficiently and safely, but users may have to bear the loud noise from the motor and struggle to fit this bulky object into their kitchens. For the Juicy Salif Citrus Squeezer, the unique streamlined shape and sleek appearance is intended to engage people’s attention, but it is too “special” to be actually used and users, in turn, have to purchase another juicer in their kitchen for actual use.
For my thesis purpose, I assume that metaphor as a design approach can bridge the gap between the method and the application. I will elaborate the reasons and the theoretical foundation in the rest parts of the paper. In this section, I would like to briefly introduce the definition of metaphor and my hypothesis.

Metaphor is a design method used by designers and it was defined by Schifferstein & Hekkert (2008) when they discussed the typical example of Microsoft “desktop: “It is in this sense that designers can allow their users to understand a relatively new or complex domain (product) more easily by presenting it in terms of a domain they are familiar with”. (2008, p.340) Through this methodology, the product can not only trigger a symbolic meaning to users but also the subsequent emotional response from users. However, with the different communicative quality such as the social background, cultural value and behavior standard, the meaning and the effect brought about by metaphor will be very variable. The authority of how the artifact meaning conveys and how the design can be
interpreted should be switched from designers to users.

On the other hand, based on the functional similarity between target domains and source domains, the intention to employ metaphors is to restructure the contexts of artifacts to enable users to easily understand and reasonably use the product. Although the intention has met users’ expectation of how to operate products, how the users’ emotional reaction will be to the transfer of meaning from one domain to another among product experience has not yet been fully explored.

The emotional aspect of design process is always regarded as highly individual and subjectively variable, though it is an inevitable element when determining a users’ expectation. In order to bridge the gap between the philosophic methodology and realistic application in the emotional design, presumably metaphor will be a potential approach to resolve emotional design problems, since those two concepts share a common element: the meaning based on people’s experiences. Therefore, the main goal of the thesis is to verify whether the metaphor can effectively elicit users’ positive emotional response and serve as a helpful approach for designers to ameliorate the design process and application. Thus, I try to explore two important issues:

1. How can metaphors elicit the positive emotion from users in the process of understanding and experiencing the product as a target domain?
2. What is the effect and the benefit of metaphorical methodology to the users’ experience and the design practice?

My thesis explores these topics in the following steps: Metaphorical Methodology Hypothesis → Metaphor Application → Conclusion via Testing. The final verification of the metaphor hypothesis will be based on users’ feedback and testing. Furthermore, when considering the outcome of final applications, two significant questions will inevitably surface: first, to what extent do consumers take the meaning of the products into consideration, and to what extent are they emotionally influenced by the implication of meaning? Second, with different levels of
metaphor approaches, are consumers aware of the benefits (either emotional or functional) of these new models, and do these benefits influence their purchase decision?

1.2 Problem Statement

When I went to amazon.com to review different kinds of citrus juicers for project research, two things caused me to question whether the product uses a successful design. First, the product presentation, including the images and the detail description, allowed me to understand features of the product and distinguish it from others. Second, the customer reviews from other users serve as a helpful reference to understand “true stories” about the product from users’ perspectives. Therefore, according to these two criteria, I would like to compare two different citrus juicers from different companies, which both receive very high ratings from customer reviews but are dramatically different in product presentations. The first one is the “Tribest CitriStar Electric Citrus Juicer” from Tribest Corporation with an emphasis on intuitive operation, high performance, easy storage and easy cleaning. The second one is the “Juicy Salif Citrus Squeezer” designed by Philippe Starck from the Alessi collection with emphasis on the unique aesthetic appearance and the remarkable design icon of the 20th century.

In addition, “Tribest CitriStar” is an electric juicer, which differs from the manual citrus squeezer “Juicy Salif.” This distinction may influence one’s buying decision based on customer’s preferences. However, in terms of the meaning and emotional aspect of each product, the electric or non-electric feature is only one design element in a users’ evaluation. Figure1 shows the comparison of “Tribest CitriStar Electric Citrus Juicer” and “Juicy Salif Citrus Squeezer.” The information is collected from amazon.com.
<table>
<thead>
<tr>
<th>Figure 1</th>
<th>Tribest CitriStar Electric Citrus Juicer</th>
<th>Juicy Salif Citrus Squeezer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Image</td>
<td><img src="image1.png" alt="Tribest CitriStar Electric Citrus Juicer" /></td>
<td><img src="image2.png" alt="Juicy Salif Citrus Squeezer" /></td>
</tr>
</tbody>
</table>
| Product Features | - Auto Start/Stop: Easy one-touch operation.  
- Stainless Steel Locking Spout: Juice pours directly into glass for continuous operation.  
- Universal Ream: Allows maximum extraction from the smallest limes to the largest grapefruits.  
- Stainless Steel Screen: Fine screen prevents clogging and is easy to clean.  
- Cord Storage: Convenient adjustable cord length and easy storage. | - Juicy Salif citrus squeezer in aluminum by Philippe Starck in 1990  
- Iconic design of the 20th century that graciously welds form and function, with humor.  
- ALESSI collection |
| Customers Rate | Average rate: 4.5/5 stars | Average rate: 4.5/5 stars |
| Customers Review | “Powerful citrus juicer”  
Lynne Spichiger, November 3, 2006  
This juicer is great for citrus - lemons, limes, oranges. Easy to use and easy to clean. Most important...when you press down on the fruit, the motor keeps going and you get every last drop of juice. The motor does not stop as you add pressure, like many juicers. This one is powerful enough to do a great job! | “Amazing doesn't even begin”  
Windham M. Graves, August 7, 2009  
Honestly this is completely overkill, it’s like buying a Ferrari to get groceries... but like the Ferrari, you can just stare at it and be happy.  

“AN ALIEN HAS LANDED IN OUR KITCHEN” (5/5 stars)  
NeuroSplicer, May 16, 2011  
This beautiful streamlined citrus squeezer was designed by Philip Stark in 1990 and I had been coveting it from the moment I saw it. So, when | “SIMPLY INCREDIBLE”  
Bobby, December 3, 2008 |
This Tribest CitriStar Juicer is THE BEST you can find. It has an incredibly powerful rotator that will get all of the pulp and juice out of your fruit. It's very easy to clean and my wife and I have used it and are VERY HAPPY.

“Ugly but terrific juicer”
Linda, June 23, 2011
I bought & returned several juicers because they were junk! So, I went on line & found the Tribest Electric juicer. It is just what I wanted except I think it is very unattractive. That aside, it is very easy to use, it is very efficient & it is easy to clean.

“A Lemonade Addict's Dream Come True!”
Jubi, March 26, 2011
I got this today and already I have fallen in love with it. It does exactly what it is supposed to do, beautifully, quietly, and efficiently. I couldn’t ask for more from a citrus juicer. I am so glad I bought this.

my wife and I moved in together this was one of the first Alessi products we bought. It is solidly built and although it may not be the most practical squeezer (the citrus juice will splash around your container if it is not large enough), it has never left our counter-top.

“Marvelous kitchen sculpture!”
David B. Smith, February 18, 2010
I've seen this item in both the Museum of Modern Art and the Victoria and Albert Museum so it's a real joy to own such a utilitarian work of Kitchen Sculpture!

“A Juicy Juicer”
J. E. Merk, May 24, 2008
A great product and looks good on you counter.... most people really have no idea what it is and then there is the big, "so that's it!"

In order to effectively address my points, I selected several interesting examples of customers’ reviews from each product at amazon.com. From the customers’ reviews, it is clear that both products can elicit user satisfaction and pleasure; however, users had very different expectations for each item. For instance, for the Tribest CitriStar Juicer, customers used the words “powerful,” “incredible,” “easy,” “efficient,” “what I wanted except” and “does exactly what it is supposed to do” to describe why they were satisfied with it. Meanwhile, they used “ugly but terrific” or “unattractive” to criticize the product but this dissatisfaction was within their expectations. For Juicy Salif Citrus Squeezer, customers used “amazing,” “Ferrari,” “an alien landed in our kitchen” and “marvelous kitchen sculpture” to describe the unique aesthetics of this product. Meanwhile, they also mentioned “overkill,” “you can
just stare at it and be happy,” “it may not be the most practical squeezer” and “have no idea what it is” to indicate their concern about the idiosyncrasy of its design. Figure 2 shows the design method and application of each product.

<table>
<thead>
<tr>
<th>Figure 2</th>
<th>Tribest CitriStar Electric Citrus Juicer</th>
<th>Juicy Salif Citrus Squeezer</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Method</strong></td>
<td>High performance in function and usability</td>
<td>Aesthetic uniqueness and beauty</td>
</tr>
<tr>
<td><strong>Application</strong></td>
<td>a. The stainless steel spout to make it durable. b. The stainless steel screen makes it easy to clean. c. Enlarge the ream to fit all kinds of citrus fruits. d. Powerful motor e. The heavy and bulky base makes it stable. f. The large open of machine makes it easy to put fruits on the ream and prevents leaking.</td>
<td>a. The streamlined contour makes it elegant. b. The sleek aluminum surface makes it eye-catchy. c. The contrast of the skinny feet makes and the heavy water-drop head makes it visual interesting. d. The tall feet give a space to put a container under the squeezer. e. The alien-like looking creates a humorous sense.</td>
</tr>
<tr>
<td><strong>Compromise</strong></td>
<td>High performance but lack of aesthetic value</td>
<td>Aesthetic beauty but impracticality</td>
</tr>
</tbody>
</table>

Apparently, there is a gap between methods and applications in emotional design! Both juicers are pleasurable for most customers but they are extreme examples of emotional design. One is extremely functional but unattractive and another is extremely aesthetically engaging but confusing to use. The objective of emotional design is to eliminate negative situations that will influence users’ emotional response and subsequently cause a positive emotion in users. There are many approaches to achieve this goal but from the example of juicers, the design approach seems to emphasize a singular method and lead to an extreme application. Do designers have to compromise the bond of the method and application and lose other important values during design process? Should the meaning of the product be sacrificed in order to amplify a particular benefit of the design application? What does the role of the product meaning play between the method and application? What is the implication of the meaning to the users’ emotional response? Is there any approach beyond method and application that can be applied to achieve
emotional design?

1.3 Thesis Plan

Why create anti-negative emotional home products?

The product category to which the metaphor methodology is applied should be relevant to a given user’s emotional experience. Since people are inclined to be more emotionally involved with products at home, I would like to study “home products” as a platform to develop the concept of “experiential metaphors.”

In addition, the emotional reaction to a product is quiet variable and subjective from one individual to another, therefore it is difficult to create a product that can consistently trigger a positive emotional response from users. Avoiding or reducing negative emotion can be an alternative way to create positive emotional response. An anti-negative emotional product is a product that can avoid or reduce negative emotional response and therefore create a positive emotional reaction. It is crucial to understand how users understand and perceive familiar products (cognition and perception) and the emotional reaction resulting from these experiences. Therefore, in addition to visual aspects, the dimension that I am interested in is the experiential aspect.

Five steps in thesis process

1. Observation & Identification of problems with home products:

In order to create anti-negative emotional home products, the first step is to observe positive and negative emotional reactions to home products, specifically to find out what experiences usually cause negative emotional responses from users. I carried out interviews with people in their homes to understand the problems and observe how they navigate these problems.

2. Problem analysis & Market research:

In this step, I collect information from the interviews and identify particular products that can be potentially
improved by metaphor. After the products have been chosen, I will carry out the market research to understand solutions available in the market. I will also compare the pros and cons of existing solutions and glean feedback and reviews from consumers.

3. Product & Metaphor ideation:

There are two sections in this step. First, according to problems indentified and users’ expectation, I will develop solutions to improve the existing products. Second, based on the association between the product experience and the improved product solutions, I will develop the metaphor ideations.

4. Users Testing & Modification:

When the final solution has been developed, I will carry out user testing on the final solution to obtain objective feedbacks from users. According to the feedback, I will modify the final solution.

5. Comparison analysis and Final feedbacks:

In this step, I will compare the final improved solution with existing products and evaluate how much the product has been improved and how effectively the problems can be solved through the metaphor. My thesis paper is comprised of three main sections. The first main section explores theory foundation and hypotheses. In this section, I introduce what emotional design is and what metaphor is. For the chapter of emotional design theories, I will discuss two influential theories and compare them through product examples. For the chapter on metaphor methodology, the content will emphasize the metaphor’s impact on design application and the correlation with emotional response. I will discuss the hypotheses about metaphor methodology with a stress on the meaning and design approaches.

The second main part is design application via metaphor methodology. In this section, problems of two home products will be explored and metaphor methodology will be employed as a design strategy to develop solutions.
The application process includes problem finding, market research, survey, ideation and users testing. The last main part is a conclusion of the thesis project. In this section, the values and challenges of experiential metaphor will be addressed and other significant discovery will be discussed based on the process of metaphor application.

2. EMOTIONAL MODEL LITERATURES REVIEW AND EXAMPLES IN DESIGN

2.1 Design for Emotion, Experience & Meaning

To understand what emotional design can do for product design and user experience, I have reviewed several emotional design essays and theories from different authoritative books. To summarize the most relevant content to my thesis topic from these books, I will use questions to point out the most significant and essential theories and statements.

1. How do people have emotional response to the product?

Daily, we make decisions to choose one option or take action and all decisions are made not only based on our rational reactions, but also our preferences, how we feel about something, past experience and most importantly our emotions. "The emotions we feel allow us to assign meanings to the people and thing that we experience in life" (Gorp and Adams, 2012). The products that we use, the machines that we interact with and even the food that we eat daily all constantly trigger emotional responses. The emotional responses to these objects or products could be satisfactory, surprising or disappointing and these responses are all based on how we experience or interact with them, just like how we interact with people and society in our daily life. "When we use products, website and software applications, we experience complex social and emotional response that are no different from the response
we experience when we interact with real people in the real world" (Desmet, 2002). "We unconsciously perceive and interpret emotional expression in the things and then form relationships with them based on the personalities we've given them" (Reeves & Nass, 1998).

People's emotional reactions are mostly affected by their past experiences and memories, and these also form a critical driver for people to select things that will catch their attention or not. Emotion demands attention and affects memory. "The intensity of emotional experience has been liked with the strength and clarity of memories before, during and after emotional events" (Reeves & Nass, 1998). Triggering an emotional response begins with a stimulus that is "emotionally competent"(Damasio, 2003). Stimuli can be the external elements, which includes people, objects and experiences (events), and also internal elements, which include internal representations, feelings and memories. The "metal models"(Gorp and Adams, 2012) could be used to describe how people transfer the information that they perceive into an emotional responding process and then turn into a meaningful personal interpretation.

In Mental Models: Our emotional responses result from the internal representations that we make of external objects and internal experiences. Externally, the object may stay the same, but internally, the emotional responses and feelings we have towards it may change. On the other hand, our preexisting feelings and emotion also influence how the internal representations take shape (Gorp and Adams, 2012).

"The information we take in from both our internal and external environments informs our mental models of particular situations, our immediate surroundings and ultimately, each individual's 'reality'"(Gorp and Adams, 2012). After a period of time, the experience from mental mode and individual reality become stories of people's life and theses stories influence the way that people interpret the emotional meanings associated with their life experiences.
2. How does the meaning interpretation/association of a product affect people's emotional response?

Each person has his own particular tendency or preference to understand and interpret the meaning of things based on his own individual emotional experience.

By association, the sensory impressions that lead to emotional response are compared and linked to similar sensory impressions encountered in the past. Whether emotions are aroused by associations with past experience or by objects in the present moment, the feelings come from the *internal re-presentation* of the thing, rather than the thing itself (Gorp and Adams, 2012).

However, some groups of people may share a similar perception because they encountered a similar experience or situation in the past, and created a similar association to link to certain emotional responses. "Association can be a powerful way to connect the emotions and meaning aroused by one object or situation with another object or situation" (Gorp and Adams, 2012). For example, most people share a similar association to a red light, which means dangerous, caution or emergency. This association comes from the daily-life perception of objects or situations like traffic lights, stop signs and fire alarms. Note that the emotional response led by the association for each person may be similar but still not completely identical.
In many situations, when people make a judgment to or interact with a thing that they don't know or is new for them, they will start looking for the familiarity connected to the association that they had created or experienced before. In some cases, familiarity alone can be enough to create pleasurable emotions. Simple familiarity and positive or even neutral past experiences mean that an object is known and relatively safe...The vague feeling of discomfort is often enough of a negative response to dissuade many people from trying or approaching a new product (Gorp and Adams, 2012).

3. How does emotional response affect the product experience (positive vs. negative)?

When we feel satisfied, comfortable or surprised by the benefit or the result of using a certain product, the fidelity to the product brand will grow, the confidence with the ownership of this product will increase and even the standard used to evaluate and select other products will increase. "The effects of emotion directly influence the way we perceive our everyday lives, affecting how we categorize information, make decisions, evaluate risks and solve problems"(Isen, 1999). Therefore, as a product designer, it is very important to ensure that the consumers can elicit a positive emotional response from the experience of using the product.

However, there are some difference between unconscious emotional reaction and conscious emotional reaction.

The figure indicates how the emotional responses are affected by associations.
Unconscious emotional reactions are more consistent, and usually trigger relatively predictable patterns of behavior, whereas conscious emotional reactions are highly subjective, varied and hard to define. The following chart shows a comparison between conscious and unconscious emotional reactions.

<table>
<thead>
<tr>
<th><strong>Conscious</strong> emotional reactions to the product:</th>
<th><strong>Unconscious</strong> emotional reactions to the product:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Varied, broad and not clearly defined</td>
<td>• More clearly defined</td>
</tr>
<tr>
<td>• Highly subjective</td>
<td>• More objective</td>
</tr>
<tr>
<td>• Changing over time</td>
<td>• Remain consistent over time</td>
</tr>
<tr>
<td>• Mixed</td>
<td>• &quot;Less Mixed&quot; (Desmet, Ortiz Nicolas &amp; Schoormans, 2008)</td>
</tr>
</tbody>
</table>

Even though conscious emotional reaction is hard to define and less consistent, it doesn't mean that designers should not take it into consideration for product design development. As I mentioned early, each person has his own individual and particular conscious system to evaluate the things around him, but in most cases, this kind of particular conscious emotional response and evaluation system are commonly shared with other groups of people. Their perceptions and interpretations vary and are subjective, but the patterns are similar. The emotional appraisal theory (Desmet, 2002) supports this viewpoint.

Appraisal theory describes how we make evaluations and respond to a product. "We make appraisals when we judge a design against a concern we have. The result is an emotional response" (Desmet, 2002).

There are two dimensions of emotion that we experience:

**Value**: a mental judgment influenced by experience

Unpleasant  ⇔ neutral  ⇒ Pleasant

**Arousal**: level of physiological stimulation from an event, object, or experience

Low Stimulation  ⇔ neutral  ⇒ High Stimulation
Value judgment can be conscious or unconscious judgments, and these judgments are based on pain and pleasure. Conscious judgments are triggered by appraisals. "High levels of physical and mental stimulation amplify the value of an experience, whether it's good or bad. Low levels of stimulation decrease the intensity" (Gorp and Adams, 2012).

**Two kinds of appraisals are based on two dimensions of emotion:**

Primary appraisal: whether the product or the experience that I gain can meet my goal (Value)

Secondary appraisal: whether my internal interpretation and external perception can be stimulated by the product or the experience (Arousal)

"Although appraisals of the same object or situation may elicit different emotional response at different times, a similar pattern of evaluation is found in situations that evoke the same emotion" (Roseman & Smith, 2001). During the experience of using a product, a positive or negative emotional response will affect how people process the information or perform the task. A signal to continue with current behavior is caused by a positive emotional affect. A signal to adjust and change the thought process or the physical behavior is caused by a negative emotional affect. The evaluation process of information and the experience is constantly influenced by emotional affect. Each emotional dimension affects a different aspect of behavior. *Value* affects whether we approach (i.e., pleasure) or avoid (i.e., pain). *Arousal* affects how motivated we are to either approach or avoid" (Gorp and Adams, 2012).

Therefore, as the metaphor approach is used for designing a product, on an unconscious level it should be clearly indentified and consistent. On a conscious level it should be relative to and refer to the similar patterns of the value judgment experience. Especially for intentional factors that can cause positive and negative emotional responses during design process, the metaphor approach should take value effect and arousal effect into consideration.
4. Why is it so important to incorporate users’ emotional response and experience into product design development?

Firstly, the satisfaction and needs offered by the functionality and usability of product benefits are no longer enough for consumers. Emotional meaning can be more valuable to the user than functional meaning, especially when the user is actually using the product in a real scenario. More and more consumers evaluate or select a product by considering what emotional experience they may encounter instead of formalized function or features listed in the product spec.

Secondly, through the emotional design approach, the user is facilitated to understand how to interact with the new technology product and then form a new relationship with innovative product experience. "Emotion is an overriding influence in our daily life" (Damasio, 1994). For example, as smart devices and new I.E. technology like voice control become more and more popular, what the user is really concerned about is the actual interaction experience with the product, and furthermore how the product will influence his daily life. Therefore, it is all about whether the user's emotional response during the product experience has been considered and whether the product has been designed to fit the actual using experience.

Thirdly, for a company, by using the emotional design as a strategy to communicate its brand values to the consumer, the company may find an opportunity to grow its business segment or advance the company's product innovation. "Emotional design is about directing the users' attention to the right thing, at the right time" (Gorp and Adams, 2012). For example, to most people, Apple's designs are all about user friendliness, ease of use and excellent customer service, and these qualities ensure that all the users have a pleasurable experience with Apple. Indeed Apple put a lot of effort to make sure their user-centered product designs are consistent with their company's core values, including design for the user experience.
2.2 Process Levels for Product Emotion (Donald Norman, 2004)

In his book Emotional Design (Donald Norman 2004), Donald Norman conducted the framework of three levels of processing human emotion with his colleagues Andrew Ortony and William Revelle. In short, this framework was developed from psychology standpoints and established based on how a human's brain processes information in terms of the levels of sub-consciousness and consciousness, and the systems of affect and cognition. In most situations, people's behavior is subject to subconscious, beneath conscious awareness. When the brain is processing information, many judgments are determined first by sub-consciousness before they reach consciousness.

Affect is the general term to describe the judgmental system and it could be conscious or subconscious. From Norman's opinion, emotion is more about the conscious experience of affect complete with external cause and factor. However, in the affective system, emotional reaction can be conscious or subconscious. Information-processing system includes affective system and cognitive system but they are very different from each other and have different functions.

**Affective system**: It makes value quick judgments and react directly to the external environment (subconscious)

**Cognitive system**: It makes an interpretation of the world and develop understanding and knowledge (conscious)

Sometimes emotions and affective states are compelled by cognition and sometimes emotions and affects impact cognition. The emotion system is also connected to the responses that cause body and behavior to react to a given situation. Affect, emotion, and cognition have built a certain connection to interact with and complement one another.

"Everything you do has both cognition and an affective component: cognition to assign meaning, affective to assign value...the affective state, whether positive or negative affect, change how we think" (Norman 2004).

**Three different levels of the brain process human emotions**

**Visceral**: This is an automatic, pre-thought and biologically determined response. The emotional affect is on a subconscious level. For product design, the appearance and the first impression are important on this level. Visceral
design is about the initial perception of a product, visual appearance, touch and feel.

**Behavioral:** This part controls daily behavior, execution of well-learned routine and skills. The emotional affect is on a subconscious level. For product design, it is about the functionality, performance and usability of a product. The visceral and behavioral levels are about the present feeling and experience of actually seeing or interacting with the product.

**Reflective:** This is the contemplative part of the brain. It is about cognitive representation of self-image, cognition and self-interpretation. This level contains the highest levels of feeling, cognition and consciousness, and it is where the impact of both thought and emotions are fully experienced. Among the three levels, the reflective level is the most subject to individual variation through culture, experience, education and individual differences. Compared with other two levels, the reflective levels can last much longer through the reflection on the past and contemplation of the future. This level also can override the other two levels. In product design, reflective design is about building a long-term relationship with the user and creating a satisfactory ownership of a product or the product experience. The impact of reflective design mainly comes through the user's retrospective memory and reassessment of the relationship between the user and the product.

In product design, these three levels correspond to product characteristics as follows:

- **Visceral design** → Appearance, sensory attributes
- **Behavioral design** → Usability and effectiveness of use/performance
- **Reflective design** → Self-image, personal reflection, memories

What Norman suggests about the relationship between the three levels is that they all interact with and affect one another. When activity is initiated from the lowest level, visceral, it is called "bottom-up." When the activity comes
from the highest level, reflective, it is called "top-down" behavior. "Bottom-up processes are those driven by perception whereas top-down are driven by thought" (Norman 2004). From Norman's perspective, whether the activity is "bottom-up or "top-down," they should all complement each other in any design.

Like subconscious level design, visceral level design is more consistent and easy to predict, but design for behavioral and reflective levels will involve both subconscious and conscious affects. They are subject and sensitive to individual experience, behavioral pattern and cultural background. Especially individual culture can make a substantial impact here. For example, one may interpret a piece of wooden craft as appealing design, while another with a different cultural background may not. That is the variation between one individual information-process experience and another.

Regarding the conflict that exists among different levels of emotion, in Norman's opinion, this conflict is very common in design. Real products provide a continual set of conflicts. "A person interprets an experience at many levels, but what appeals at one level may not at another level." "A successful design has to excel at all levels" (Norman 2004).

2.3 Pleasure Needs for Product Emotion (Patrick Jordan, 2000)

Patrick Jordan's pleasure theory is fundamentally based on the disagreement of usability-based approach as a singular human factor standard for product development or evaluation. As he emphasized in his book, Designing for Pleasurable Products "the problem with usability-based approaches - they tend to encourage the view that users are merely cognitive and physical components of a system consisting of the user, the product and the environment of use" (Jordan, 2000). In addition, people are no longer satisfied with the usable value of a product, but are easily disappointed by difficulty in use. Compared with usability-based approaches that only conduct a limited view of the person using the product, pleasure-based approaches tend to value and look at the whole user experience holistically.
Pleasure-based approaches are initially influenced by a "hierarchy of consumer needs," a concept developed by the psychologist Abraham Maslow (1970). The concept explains that once people achieve their needs on the bottom of the hierarchy, they will continue to seek needs higher up. Therefore, if a basic need, such as safety or physiological satisfaction have been met, people will still feel a longing to meet their higher needs. The following diagram shows the hierarchy of need as it corresponds to human factor models:

![Hierarchy of Needs Diagram]

Another important concept from Jordan's pleasure theory is "living object." "Products that are not merely tools but 'living object' that people can relate to; products that bring not only functional benefits but also emotional ones" (Jordan, 2000). He stated a product or object is not a meaningless existence, but like a living person that others can have relationships with. This perspective is similar to that of Reeves & Nass (1998) and Desmet (2002), who address the relationships between people and products. The emotional response that people elicited from a product is nothing different from how people interpret the meanings of products and form relationships with them.

Jordan considered pleasure-based approaches as challenges for the new human factors, and he thought human factors must move beyond usability in order to address relationships between people and products holistically. "It is necessary not only to have an understanding of how people use products, but also of the wider role that products play in people's lives" (Jordan, 2000).

**The four Pleasures:**

Pleasure can be defined as: "Pleasure with products: The emotional, hedonic and practical benefits associated with
products” (Jordan 1999). How a product affects or improves the user's mood are the emotional benefits. For product design, the intension of pleasure-based approaches considers all the potential benefit that a product can deliver to the user. Pleasure-ability from a product is not just a property of the product, it comes from the interaction and the relationship between a person and a product. Pleasure can be regarded as the removal of pain and unpleasant experience and also as the provision of positive feeling and experience.

Canadian anthropologist Lionel Tiger developed the framework of the four pleasures, in which he modeled four conceptually distinct types of pleasure: physical, social, psychological and ideological.

**Physio-pleasure:** This pleasure is caused by the body and sensory organs, like tactile or olfactory.

**Socio-pleasure:** This pleasure is derived from relationships with other people, like friends or colleagues. It also includes a person's relationship with society as a whole, such as social identity.

**Psycho-pleasure:** This pleasure is about cognitive and emotional reactions to the product.

**Ideo-pleasure:** This pleasure is about people's values and self-esteem with a product such as the values that a product can represent.

To apply this four-level pleasure approach to design, Jordan suggests that one considers all four types of pleasure to solve or address an issue, but it is not necessary to provide all types of pleasures to the product. Ultimately, what product benefits can be identified and provided to the user in terms of the holistic aspect of using experience and emotional responses are the main intention of this pleasure-based approach. This approach should be used as a tool to help design development instead of a theory to constrain the design.

### 2.4 Comparison and Examples in Design Application

For the framework of the emotional responses, Jordan and Norman seem to use distinct methods and systems to distinguish emotional levels. While Jordan establishes an emotional framework on the basis of different levels of
pleasure needs, Norman develops a framework on the basis of different levels of information processing in the brain. However, there is some correspondence between those two emotional frameworks. Visceral level emotion corresponds to physio-pleasure, behavior level emotion to psycho-pleasure, and reflective level emotion to socio-pleasure and ideo-pleasure. In addition, they all suggest that the emotional responses from different levels may be a mix of different emotions elicited by different types of sources. The system of emotional responses to the products should be dynamic and interactive instead of being static and fixed.

Let's take one product for example with a fictional persona to explain emotional responses from different levels of these two frameworks and how they might be correlated.

Product: Jabra SOLEMATE / Persona: Gary

Jabra SOLEMATE is a Wireless Bluetooth Portable Speaker and Gary bought this product six months ago. He is an outgoing person and likes to do outdoor activities such as hiking, biking or camping in his free time, so he appreciates a product with active attributes for outdoor scenario. He also enjoys listening to music in his apartment to relax, so the product needs to be versatile for in-home use as well. While having a bath, he uses this speaker to play music, because the wireless function makes it easier to control music from his phone. Sometimes on the weekend, he takes the speaker to the park for a picnic with friends, since its compact size makes it portable. At a dinner gathering in his apartment with friends, he places the speaker on the center of the table so the music can reach everyone. So far, he is very satisfied with this product.

**In the level of Visceral response and Physio-pleasure:**

Gary is happy with its versatility for different occasions, the high quality sound performance and the portable size.

Product Attributes: robust rubber base, soft touch finishing, high quality sound performance, compact

**In the level of Behavioral response and Psycho-pleasure:**

Gary finds it convenient to control music from his phone or the buttons on the speaker, and simple to set up
Bluetooth pairing. Product Attributes: simple interface on the speaker, convenience of Bluetooth function, simple step to pair Bluetooth signal

In the level of Reflective response and Socio-pleasure and Ideo-pleasure:

Gary also feels that this speaker can reflect his affinity for the outdoors and can also be used to create a good time with his friends. Product Attributes: reflection on personal outdoor lifestyle and a purpose to create a better experience with his friends

3. METAPHOR LITERATURES REVIEW AND HYPOTHESIS IN DESIGN

3.1 What is Metaphor? Why is Metaphor?

Metaphor originally is from linguistic expression to describe a thing or imply thing in a literature. In traditional linguistics, metaphor is a property of words; it is a linguistic phenomenon; used for artistic and rhetorical purpose; is based on a subjective resemblance between the two entities; a conscious and deliberate use of words; a figure of speech for special effects and it is not inevitable. However, this traditional linguistic view is challenged by George Lakoff and Mark Johnson and their seminal study: "Metaphor We Live By"(George Lakoff and Mark Johnson, 1980) known as the contemporary cognitive linguistic view. Lakoff and Johnson claimed that:

1. metaphor is a property of concepts, and not of words.
2. the function of metaphor is to better understand certain concepts, and not just some artistic purpose.
3. metaphor is often not based on similarity.
4. metaphor is used effortlessly in everyday life by ordinary people, not just by special talented people.
5. metaphor, far from being a superfluous though pleasing linguistic ornament, is an inevitable process of human thought and reasoning.

In their view, metaphor is not just about words or linguistic expressions, but more about how people conceive understand concepts and think of one thing in terms of another. This theory has been tested by cognitive researchers who have shown that the cognitive view of metaphor is viable in psychology, and can been seen as a key method to organize human thought and even be used for practical applications. Metaphor is not only expressed linguistically but also in nonlinguistic reality such as movies, cartoons, drawing, buildings, advertisements and cultural symbols. The purpose of the conceptual metaphor is to understand or conceive one abstract concept by using another more concrete, physical and tangible concept. To better understand what metaphor is and how it has been defined, I referred to the book "Metaphor: A Practical Introduction" wrote by Zoltan Kovecses (2010).

- In the cognitive linguistic view, metaphor is defined as understanding (or interpreting) one conceptual domain in terms of another conceptual domain.
- A convenient shorthand way of capturing this view of metaphor is the following: conceptual domain A is conceptual domain B, which is what is called a conceptual metaphor.
- The conceptual domain form which we draw metaphorical expressions to understand another conceptual domain is called source domain, while the conceptual domain that is understood this way is the target domain. The target domain is the domain that we try to understand through the use of the source domain.

The Basis of Metaphor in Cognitive View

Experiential basis of a metaphor is the conceptual metaphor based on a variety of human experience, perceptual, biological or cultural. From this book, I summarized theories that explain how different cases of metaphors are grounded.

Three common bases to form the metaphor in the contemporary cognitive linguistic view:

a. Systematic correspondences or mapping between constituent elements of the source and those of the target

For example, purposes are destinations (reaching one's goal); ideas are food (discussing a suggestion).

b. Correlations in bodily, emotional or cultural experiences shared by two concepts, and possibly others
For example, anger is heat (make one's blood boil); argument is war (my team lose the battle).

c. Perceived structural and non-subjective similarity shared by one abstract concept and the other concrete concept. For example, life is gambling (the odds are against me); life is a journey (we face a crossroads).

In the metaphor mapping structure, a target is not entirely understood by a source. That means that the mappings between a target and a source are and can be only partial. Only a part of the source is mapped onto the target and only a part of the target is involved in the mappings from the source.

Another important issue in the mapping is the real-time or off-line comprehension between two conceptual domains. Many metaphor scholars prefer to use the word "construe" or "conceive" than "understand" in the characterization of conceptual metaphor. In most metaphors, the way that people talk about or think about the conceptual metaphor between two concepts is not necessarily to evoke images of real-time, online process of understanding. For example, life is a journey. We don't literally think about the real-time image of journey to interpret the concept of life. In a process of conceptual metaphor, a more abstract concept is construed through a more physical concept off-line and by mean of long-term memory or a historical-cultural process. Thus, in the metaphor, life is a journey. The concept of journey actually "creates" the meaning and the interpretation of the concept of life.

3.2. How does Metaphor affect Product Design and User Experience?

The principle of conceptual metaphor in cognitive linguistic view has been used as a design approach for product design development. Specifically, through the metaphor approach designers can allow the user to understand relatively complex or new product experience by referring to what they are familiar with. I use some examples to explain how metaphor can be used in product design and why it can be a useful approach to solve design problems and even promote a new meaningful design experience. Some examples are from “Product experience”( Schifferstein & Hekkert, 2008).
**Metaphor and Product Analogy: Muji CD Player**

Analogy is different from metaphor and it is one part of metaphor process. While the meaning transfers from the source domain to the target domain, analogy only involves the functional similarity between the target and source. Thus analogy only represents the characteristic resemblances between two objects, phenomenon and experiences; it doesn't involve meaning transfer. Take Muji CD Player as an example that also has been used to explain the differential between metaphor and analogy in “Product experience” (Schifferstein & Hekkert, 2008).

The way to pull the cord to turn on or turn off the music is similar to the way one switches on or off a light. If one only looks at this connection between those two objects (music switch and light switch), this functional similarity is merely analogy and it doesn't involve a meaning transfer yet. However, once the consumer perceives or understands the design intention further, they may start to consciously or subconsciously correlate the meaning or experience of the need of the light to the need of the music in their daily life. From here, the domain of light is meaningfully transferred to the domain of music and the metaphor is "music is light." The music, just like the light is indispensable in our daily life and should be as easily reachable as the light.

**Metaphor Integration in Product Design: Windows Desktop**

When users conceive a new interpretation of a target domain created by a source domain, they actually experience a "merging" of the two domains. "As a result of this merging, we usually do not distinguish between source and target in the experience of product; what is experienced is an integrated, seemingly novel phenomenon" (Schifferstein & Hekkert, 2008). Metaphor integration theory was originally developed by Fauconnier and Turner (2002), and they maintain an integrated form with its own coherent structure and properties becomes a novel interpretation that
comes from the merging of two or more domains, as a "blend".

Take Windows Desktop system founded by Bill Gates and Paul Allen as an example. Most people are able to easily learn how to use the Windows system by referring to the metaphor of "desktop". The source domain of desktop allude not only to a single item of the office desk bust also the whole office work environment. For example, when we use this computer interface, we all have a similar experience when we open the folder, move the folder, save the file, copy the file, close the window, move this file to the trash can, create a shortcut on the desktop or display the tool bar. Apparently, there are multiple domains to form a "network" connected source domain, which means those multiple source domains are all coherent and correlative with a generic systematic experience. For example, people who work in an office will store a file in a drawer, copy the document from a machine, shred the document to the trash can and open the file cabinet to look for a folder. Those scenario cases are all reasonably related to each other in the office environment so they can form a network-connected source domain. When users conceive how this Windows system works in terms of a network-connected source domains and then manipulate this interface , they don't just simply copy the ideas from the source domains and apply them to structure of this interface, like analogy but rather they integrate the source domains with the target domain to form a re-adopted new systematic experience. For example, when a user tries to organize the files and the folders in the desktop, he doesn't literally think about the ideas of getting a pile of files from the cabinet, labeling them and then categorizing them into different piles and storing them back to the cabinet. However, in the computer interface, he will drag a file or folder from one window to another and rename the folder and move them to a relevant folder location, so the whole experience is based on the adopted interpretation of an integration of the target and source domains. Based on these differentials and variations within the process of forming a conceptual metaphor, I summarize and layout the levels of meaning transfer in Conceptual Metaphor as follows.
Metaphor to Promote New Meaning: PhoneBlok Project

In this example, metaphor is used as a core method by designers to develop a new product concept and also as a strategy to promote its concept to the consumer. PhoneBloks project or Project Ara (renamed later) was developed by Google and Motorola and is scheduled to launch in 2015. The design intention of this project is to create a modular system to a cell phone that makes it easier for the users to replace, exchange, upgrade and customize any functional component in their cell phones based on their personal needs. Another intention of this project is to reduce electronic wastes and prolong the cell phone life span. Instead of throwing away the entire cell phone, if only some of parts are broken, the consumers can just simply replace or upgrade the defective parts through this modular system.

Phonebloks consists of a main board onto which bloks could be snapped on by the user like Lego bricks. Each blok is responsible for a unique function of the phone, much like a desktop computer has a distinct sound card, graphics card, processor, monitor, and power supply (Leather, Forbes.com, 2013)

Metaphor here serves two different functions to two different groups of people. First, designers use the metaphor of Lego bricks mechanisms as an approach to simplify this complex modular cell phone system and to deliver an achievable experience so just like Lego bricks, the cell phone can be disassembled and re-assembled to create a customized functional cell phone. Designing a modular cell phone system is like designing a playful Lego brick
system. Designers use the Lego brick metaphor to add a playful value into the design development process.

Second, the company also uses the Lego brick or block metaphor as a strategy to help the consumer to quickly understand how easily it works with the modular system and demonstrate the benefit of being able to customize. The user may perceive how convenient and intriguing this modular experience will be on their cell phones due to the association with the playful and spontaneous values of building with Lego bricks. Building a modular cell phone is like building a playful Lego bricks or blocks. Note, in the meaning transfer process of metaphor, the systematic mapping between building the modular system and playing with Lego bricks not only rests on the resemblance of a "building" experience on a behavior level but also the experience of being playful and personalized on a cognitive and self value level.

PhoneBloks Project

3.3. Beyond Language: Functions and Applications of Metaphor in Design

a. The purpose for users:

• Help users understand complicated, unfamiliar or innovative products

• Affect users’ emotional response from cognitive (how to think), behavioral (how to react), social convention (group affiliation) and personal value (memory and attachment)
b. The solution for designer:

  • Designers may employ this method to “direct” users to use and understand the product.
  • Based on the user-centered research (common experience and understanding), designers may create
    a new meaning for products.

3.4. Hypothesis: Meaning as a Correlation between Metaphor and Emotion

Based on three bases to form metaphors:
1. perceived structural and non-subjective similarity
2. Systematic mapping between two domains
3. correlations in human experience

Based on individual experience, co-experience and cultural variation to interpret and identify the meaning outside self

Based on two emotional response models:
“Pleasure approach to product emotion”;
“Process-level approach to product emotion”

As the above diagram shows, the area where metaphor and emotion overlap represents “meaning,” which is based on individual experience, co-experience and cultural variation. Therefore, I can speculate that the utilization of metaphor can affect emotion through the manipulation of meaning. However, the relation between metaphor and emotion is one-sided which means emotion only can be the consequence caused by metaphor not as a motive.
Example showing the relationship between metaphor, meaning and emotion:

The incorporation of Metaphor (methodology) and Emotional (response):

In order to examine the connection between metaphor and emotion, I adopt two authoritative emotional design theories introduced by Patrick Jordan and Donald Norman due to their reliability and dominance in their fields.

First, “Pleasure approach to product emotion” introduced by Patrick Jordan (2000)

It is on the basis of differentiated need.

Four distinct types of pleasure that people may seek or caused by product affect:


It is on the basis of levels of processing in the brain.

Three levels of information processing: reactive; routine; and reflective.

Three distinct types of product affect: visceral affect; behavioral emotion; and reflective emotion
Since emotion is the consequence caused by metaphor in the process of meaning transfer, different emotional processes and effect levels can be used as criteria to classify metaphors as different stimuli for emotion. Based on above two approaches to appraise (positive) product emotion from users, I initially develop four metaphorical methodologies corresponding to product emotion appraisal:

### 3.4. Hypothesis: Four Metaphorical Design Approaches

**Semantic Foundation**
(based on individual experience, co-experience and cultural

- **Pleasure approach to product emotion**
- **Process-level approach to product emotion**

**Metaphors → Psychological Aspect**
(What or Why do users think or behavior in the way due to or responsive to certain meanings from the product?)

**Synthesis**

**Relationship with Object**
Controlled within individual

- **Tangible Metaphor**
- **Behavioral Metaphor**

**Relationship with People**
Influenced by outside factors

- **Social Metaphor**
- **Reflective Metaphor**

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1. **Tangible metaphor approach:**

**Definition:** Metaphor is based on the sensory perception and the visceral reaction from users.

**Practice:** Ideation is related to how the tangible attributes of the product (such as visualization, texture or function) are connected to users’ senses and how users meaningfully interpret them.
**Expected effect:** Users may feel more comfort and pleasure both in their sensation and mental condition when using the product.

2. **Behavioral metaphor approach:**

**Definition:** The metaphor is based on users’ cognition for products and how users interact with, understand and manipulate the product.

**Practice:** The ideation is related to usage experiences and behavior patterns from the relationship of users and the product interface.

**Expected effect:** Users may feel more comfort and pleasure, and show more understanding for the product when operating it.

3. **Social metaphor approach:**

**Definition:** The metaphor is based on the cultural value, group affiliation and the co-experience.

**Practice:** The ideation is related to how most people interpret the socially semantic aspect of the product, the scenario from the interaction with other people and social & cultural stereotype.

**Expected effect:** Users may feel more confident and pleasure due to the appropriate social of the product when using or possessing the product.

4. **Reflective metaphor approach:**

**Definition:** The metaphor is based on self-standard, personal value and memory.

**Practice:** The ideation is related to a particular group self-estimate which results from a unique quality or a particular event.

**Expected effect:** Users may feel more satisfaction and pleasure due to the self-value reflected from the product when using or possessing the product.
Each metaphor approach will be conducted on an individual home product selected from research and the item will be developed to match expected emotional response from users. Although the above product emotional approaches may not cover all emotional scenarios activated from people since the stimulus (including objects, events and locations) may be variable and even unpredictable, and some of the emotional responses and effects could be a combination of mixed types (and sometimes paradoxical), these four metaphor approaches are the primary concepts (like archetypes) used to develop the product with the subsequent modification by any new discovery. Therefore in the application stage, it is possible to apply more than one metaphor approach to any single one product.

PART2: APPLICATION OF METAPHOR & EMOTION HYPOTHESIS

4. Application Brief Revisit

4.1. Anti-negative emotional home products

Since people are more inclined to be emotionally invested in products in the home, I would like to explore “home products” as an effective platform with which to develop the concept of “experiential metaphors.”

Why “anti-negative?” The emotional reaction to the object (product) is a quiet variable and subjective from one individual to another, therefore it is difficult to create a product that can consistently trigger a positive emotional response from users. Avoiding or reducing negative emotion can be an alternative solution to potentially create a positive emotional response. **Therefore, the anti-negative emotional product is the product that can reduce negative emotional response and potentially create positive emotional reaction.**

To address the points outlined above, it will be critical to understand how users perceive familiar objects around them (cognition and perception) and the emotional reaction resulting from these experiences. Therefore, instead of only visual aspects, the dimension that I am concerned with is the experiential aspect. In order to create
anti-negative emotional home products, the first step is to research what positive and negative emotional scenarios would be for home products, specifically to find out what experiences cause negative emotional responses from users.

4.2. Consideration for Design Process

Designer’s Assumption and Empirical Investigation:

In the pre-concept development stage, since the anticipation for products is no longer ruled by designers, participation from consumers will be key to ensure that the conception is closer to the actual product use scenario. However, after several interviews with users to investigate the product problems in their homes, it is difficult to identify a problem that can be addressed by designers, since people usually have compromised the product problems in their house. Apparently, it is still important for designers to conceive initial visions and prediction for product problems and formation. Therefore, two activities will be carried out simultaneously: “designer assumption” and “empirical investigation.” There are three essential aspects that will be defined and taken into consideration in order to build effective analysis information, primarily thorough the following two activities: user, product type and context of use.

Metaphor benefits design on the following assumptions:

- The Metaphor application helps designers to create a meaningful design with positive product experience
- Achievement: enhance the usability, meaningfulness of product and user experience
- Value for designers: develop a new meaning in concept development stage
- Value for users: make users feel more meaningful and positive; make products easier to use

Why did I choose the light switch for the metaphor design application?

First, in order to prove the function and the benefit of metaphor design methodology, I wanted to focus on the design
intention for users and the process executed by designers. The light switch is indeed something that most people have issues with daily. It is also something from which users experience comprehensive emotional responses. Second, although the light switch is a humble product that everyone uses in their homes daily, a more positive experience may be made possible through the improvement of its design by the metaphor approach.

5. Product 1: Timer Light Switch

5.1. Observation & Problems Identification

About Automation Light Switch

The auto-light switch includes a motion sensor and a timer switch. The former can be activated by movement and the latter can be activated by pushing a button. Both of them will automatically shut down the light after a short period of time, e.g. 30 seconds or 1 minute. Some timer switches can be programmed to follow a predetermined timing pattern. The purpose of the sensor switch and the timer switch are to save energy and prevent energy wasting. The sensor switch or the timer switch can be used in various spaces in the home, such as garage, entry, hallway, stairwell, kitchen or bathroom.

Initial problems of the auto-light switch (sensor switch and timer switch) are found based on online customer reviews:

• The time span is fixed and cannot be adjusted when the machine is in use.

• There is no clear signal to indicate how much time the light is left.

• The display text on most timer switches are hard to read.

• It is difficult to find the (automation) switch in the dark.

The storyboards below show a typical scenario that users may encounter. For the motion sensor switch, it is convenient to use when a user already has her hands occupied and has no spare hand to turn on the light switch.
However, sometimes the sensor switch shuts off the light suddenly without any signal, which may cause annoying results. For the timer switch, it is very useful to have a numerical scale for time span adjustment. However, it can be difficult to read the numbers in the dark, and the small text also makes it difficult to read for timer adjustment.

5.2. Market Research

I conducted market research to look at different types of auto-light switch in terms of functionality and special features. I added notes on positive and negative comments based on the online customer reviews in order to define the design objective.

Synthesis & Recommendation:

1. Motion Sensor Switch: easy to use but limited adjustability

2. Programmable Timer Switch: highly functional but complicated to set up

2. For digital switch, the flexibility to use auto-switch is limited by pre-set program.

3. For manual switch, the legibility is compromised by it physical printed text and mechanism.

Design objective is focused on semi-auto switch with better legibility and flexibility for use experience.
5.3. Questionnaire Survey

A questionnaire survey about the experience of using an auto-light switch was conducted by 28 respondents who are anonymous students and faculty from R.I.T. in order to understand a small group of people's expectations, concerns and needs. The description of the questionnaire is as follows:

The timer switch that I want to investigate is one that can be used without having to be programmed in advance.

Part A: Investigate product problems at YOUR HOME

1. Auto-light devices are convenient.
   - Strongly Disagree [ ] Neutral [ ] Disagree [ ] Agree [ ] Strongly Agree [ ]

2. I believe that auto-light devices can save energy.
   - Strongly Disagree [ ] Neutral [ ] Disagree [ ] Agree [ ] Strongly Agree [ ]

3. With push-button switches, it is difficult to find the device to turn on the light in the dark.
   - Strongly Disagree [ ] Neutral [ ] Disagree [ ] Agree [ ] Strongly Agree [ ]

4. I get annoyed when the light automatically turns off without warning or signal.
   - Strongly Disagree [ ] Neutral [ ] Disagree [ ] Agree [ ] Strongly Agree [ ]

5. It is inconvenient when I accidentally trigger the motion sensor light.
6. It will be helpful for me to somehow control the auto-light device.

Part B: Solution Research

1. What is the primary reason for you to use an auto-light device at home?

2. Where would you like to install the auto-light device in your house?

3. Which feature can make it more convenient to use an auto-light device at home?
   (multiple choice)
   [ ] A. Time countdown indication  [ ] B. Time extendable function by manual control  [ ] C. Accident activation avoid  [ ] D. Strong Visibility  [ ] E. Ergonomic  [ ] F. Other

4. What kind of signal can help me to know that the light is going to be turned off at home? (multiple choice)
   [ ] A. Number showing how much time left  [ ] B. Warning sound  [ ] C. Light signal  [ ] D. Light color change  [ ] E. Other

5. What other features do you think can facilitate using auto-light devices?

Significant finding from the survey:

57% of people think that Ease of use (to program) will make auto-light switch more convenient to use.

54% of people think that Energy cost saving is the primary reason to use auto-light switch in home.

50% of people think that Accidental actuation avoidance (to reduce false triggering of motion-sensors) is important.

46% of people think that it is inconvenient when I accidently trigger the motion sensing light.

40% of people think that it is annoying even dangerous when a motion sensor turns the light off without warning

Design opportunity:

1. Increase the visibility of light-controlling devices in the dark

2. Enhance the flexibility and adjustability of light-controlling devices:
   a. Eliminate auto-function and instead adopt a semi-automatic approach
b. Make the timer device adjustable according to users' needs

3. Enhance the legibility of light devices:

a. Devices will clearly indicate how much time remains

b. Process for controlling the device is easily understood

5.4. Metaphor Ideation

Light is powered by electricity, and the switch is used to control the electricity. Thus, to turn on the light is actually to turn on the electricity. In order to allow the user to conceive an understandable concept and easily control the auto-light switch, I began with a metaphor of "Light is electricity" and then developed it into "light is a tangle of energy." "Light" is something can be physically caught and touched. I use "catch the light" and "release the light" as metaphors for controlling the light. To turn on the light is to catch “the light” in a cage, so “the light” will circulate the whole light device. To turn off the light is to release “the light” from a cage, so “the light” will elude from the light device.

The correspondences between "turning on/off switch" and "catching/releasing light" in metaphor are as follows.

a. Associate invisible electricity with visible light and turn it into energy that can be caught to be harnessed

b. Associate electricity circulation with light emission so as to catch light in a cage is to circulate the device

c. Associate the concrete concept of "catch" and "release" with the abstract concept of "turn on" and "cut out"

The light catcher is a timer switch with a LED light, a cage with a handle on it, and a built-in mechanical timer. The LED light emits from the cage, so users can easily find the switch in the dark. When the cage is closed by the user, the indoor light will turn on. Meanwhile, the cage will automatically open at slow and measurable speed so the user can easily notice how much time is left. Once the cage is completely open, the indoor light will turn off. The time span can be set from 1 minute to 30 minutes. The time span can be flexibly adjusted by closing the cage or cut down
to turn off light immediately by opening the cage anytime.

Benefits for users from this metaphor concept:

• Users can easily find the switch in the dark and close the cage to turn on the light.
• Users will understand how much time is left from the extent to which the cage is open.
• Users can flexibly adjust the time span or shut off the light by closing or opening the cage.

Overview of "Light Catcher" metaphor concept

5.5. Product Ideation

Based on the initial metaphor concept: light catcher, I developed different design directions. I use LED light change to indicate time span and offer more visibility in the dark. Instead of a fully automatic operation, a manual control is added to the switch.

**Toggle Switch Direction- incorporate metaphor into existing product**

**Concept A**: It is a toggle switch with light emission from the top. Press the button to catch the light. LED timer indicates on the base.

Pros: Large LED timer on the base provides good visibility

Cons: The switch may not directly relate to the timer on the base
**Concept B**: It is similar to Concept A but the time span indicator is integrated with the prolonged button.

Pros: LED timer indicator integrated on the switch to make it intuitive to read

Cons: The larger toggle switch may make it difficult to turn it down and up

**Movement Association Direction-use behavior tendency to associate metaphor**

**Concept C**: It is a button switch with a light concentrated in the center. Press the button to spread the light into the room.

Pros: Minimal design makes it simple and intuitive to use

Cons: The button can be pressed to extend time or to circle through all the functions

**Concept D**: It is a push-and-pull button. Press the button to spread light out and pull the button to withdraw the light back.

Pros: The button allows to push and pull for time extension or time deduction; more flexible to use

Cons: The form may need to be refined and simplified to fit the home environment

**Tangible Object Direction-use meaningful object to associate with metaphor**

**Concept E**: It looks like an upside down bottle. Slide down the cap to release the light. Close the cap to retain the light.

Pros: The sliding mechanism of the cap is as easy to understand as the sliding switch. LED timer indicator on the bottle is very legible

Cons: Upside down bottle associates the light with something flowing down and that may cause confusion

**Concept F**: It looks like a suitcase. Open the suitcase to release the light to the room and close it to withdraw the light.
Pros: The open-close mechanism is similar to the toggle switch. LED timer indicator is very clear on the button.

Cons: The suitcase form and meaning may not match the image and meaning of the light retention as LED indicator on the button.

**Concept Selection: Concept D and E**

In terms of usability and the user experience of product design, Concept D and E both feature more intuitive light switch control and more legible LED timer display for the user. In addition, the metaphor concept of the light catcher in both concepts may not only demonstrate a meaningful presentation to the user but also create a pleasurable storytelling quality to enhance the user experience.
Overview of product ideation based on metaphor concept:
5.6. Selected Concepts Evaluation

The mock-up of selected concepts have been made with some modifications based on initial pros and cons. For example, the form of concept D is refined to be softer and have a less industrial feel. In Concept E, the bottle is changed to face up with softer surfacing form. The second evaluation is conducted based on mock-up testing to determine the final concept.

Selected Concept 1: Light Retention - Manual Timer Switch

Users can control the switch by "Retaining" or "Releasing" the light. The metaphor approaches that are used as follows:

1. **Tangible metaphor approach**: The soft surfacing, bottle form with LED light inside associates with a container filled with liquid.

2. **Behavioral metaphor approach**: The way to slide up or down the cap associates with the way to open and close the bottle.

3. **Social metaphor approach**: Opening the cap to release something from the bottle is recognizable by shared memory, eg. perfume.

**Steps of use**:

Step 1. Open the cap to turn on/ release the light, open more to extend more time. LED light decreases if the cap is opened more.

Step 2. The cap automatically moves back to count down after being removed from the bottle. LED light adds up to fill up the bottle.

Step 3. Till the cap is closed, then the light will be turned off.

Step 4. Immediately turn off the light anytime by closing the bottle.
Pros | Cons
---|---
+Clearly perceive the time span by change of LED light | -Without any calibration, it's hard to precisely measure the time span.
+Bottle metaphor makes it intuitive to operate the switch | -Will it be difficult to recognize as a light switch?

**Selected Concept 2: Light Catcher- Manual Timer Switch**

Users can control the switch by "Pushing" or "Pulling" the light. The metaphor approaches used are as follows:

1. **Tangible metaphor approach:** The central button with light and the base associate with something that can be pushed and pulled.

2. **Behavioral metaphor approach:** The actions of pushing and pulling respectively associate with adding and deducting.

3. **Social metaphor approach:** Pushing to give in the light and pulling to withdraw it are understood by most people.

**Steps of use:**

Step 1. Push it to turn on the light and push more to extend more time

Step 2. The ring of LED light starts decreasing to count down after pushing the button.

Step 3. Till the LED backs to the button, then the light will be turned off.

Step 4. Immediately turn off the light anytime by pulling it.

After evaluating both concepts on time adjustment, suitability in style for the home and simplicity, Concept 2 has more advantages than the other, and will be refined further as the final design.
Selected Concept 1: Light Retention - Manual Timer Switch
Selected Concept 2: Light Catcher- Manual Timer Switch
5.7. Final Design: Light Catcher Plus
Semi-Auto Timer & Motion Sensor Switch: A sensor and time scale are added to this concept to make it more versatile.
• Use the slider to switch between the manual timer mode or auto sensor mode
• Push/Pull the button to adjust the time span based on the LED light and the time scale
Sequence and steps of Light Catcher Switch:

A. During standby mode: Push to turn on the light (override on)

B. Pull to subtract time to set the timeout duration

Subtract time: decrease more LED rings
C Push to add more time during countdown

D Pull and Hold to turn the light off (override off)

Add more time: expands more LED rings
blue LED indicates on/off motion sensor

In timer mode, actuate the switch by pushing the button.

In sensor mode, the switch is actuated by detecting
6. Product 2: Wireless Light Switch System

6.1. Observation & Problems Identification

In this project, the goal is to solve issues and negative experiences with the light switch and access to the wall outlet in the home. The most affordable and convenient solution that most people use is the wireless light switch. A wireless light switch is a switch with built-in wireless technology and powered by replaceable AAA or AA battery that allows the user to customize the switch placement. Before we start to look at the wireless switch, it is essential to investigate user scenarios and concerns regarding issues with light switches in home.

I researched initial problems with the light switch and wall outlet by asking people about these products and consulting online customer reviews for wireless switch products.

- The location of most light switches at home may not fit needs and desires.
- It is difficult to access wall switches or outlets blocked by objects or furniture.
- Users are often confused by the functions of the switch in terms of its interface or location.

Switch at the entrance & hallway; go to turn on and back to turn off the light

**Scenario A**: the user is confused by which switch controls which light

**Scenario B**: the user need to find the switch in a dark space

Switch in the room & the stairs; go in/out or up/down to turn on/off the light

**Scenario C**: the user needs to turn on/off multiple switches in different locations

**Scenario D**: the user is confused by the locations of the switches

Outlet control in the room; multi-locations and behind/under objects

**Scenario E**: the user uses multiple wall outlets in his room

**Scenario F**: the power strip and the wall outlet are hidden behind or below the furniture
Switch at the entrance & hallway; go to turn on and back to turn off the light

Switch in the room & the stairs; go in/out or up/down to turn on/off the light

Outlet control in the room; multi-locations and behind/under objects
6.2. Market Research

A benchmark research of existing wireless switch is conducted to look at functionality and special features.
Synthesis of benchmark research based on some primary features:

<table>
<thead>
<tr>
<th></th>
<th>Light Solution</th>
<th>Outlet Solution</th>
<th>Multi-Control</th>
<th>LED Indicator</th>
<th>Expandable</th>
<th>Programmable</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Essential</td>
<td></td>
<td>GE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-Low Versatility -Poor Control</td>
</tr>
<tr>
<td>GE/Above $100</td>
<td>GE</td>
<td>GE</td>
<td></td>
<td>control 6 channels with 1 remote</td>
<td></td>
<td></td>
<td>-Un-Expandable -Poor Visibility</td>
</tr>
<tr>
<td>Lutron Above $100 or Higher</td>
<td>GE</td>
<td>GE</td>
<td></td>
<td>control 3 channels with 1 remote</td>
<td>only for wireless wall switch &amp; outlet module</td>
<td>control 10 individual switches &amp; outlets</td>
<td>10 scenes, 9 timed events -Complex Setting -Crowded Buttons -No Backlit</td>
</tr>
<tr>
<td>Lutron</td>
<td>Lutron</td>
<td>Lutron</td>
<td></td>
<td></td>
<td>control up to 10 wireless devices with the same channel</td>
<td>only for wireless wall switch &amp; outlet module</td>
<td>expand to other devices, sensor, delay function and favorite setting</td>
</tr>
</tbody>
</table>

**Conclusion & Recommendation:**

1. Essential solution device is simple and intuitive to use but lacks versatility.
2. Advanced solution devices provide expandability for versatile use but increase complexity of use.
3. The interface from most solutions is very confusing and difficult to read due to unclear information.
4. Very few solutions address the backlit function that allows the user to find the switch in dark.
5. For power strip solution, there is no flexible setting to control the individual outlet on a power strip.

Design objective is focused on the integrated solution of wireless switch and power strip control with better user-friendly features.

### 6.3 Questionnaire Survey

A questionnaire survey was conducted along with the survey of auto-light switch and answered by 28 respondents who are anonymous students and faculty from R.I.T.. This survey is to find out a small group of people's experience
of using the light switch and the outlet in their homes and their expectations and needs for wireless solution.

Survey of Electricity Control & Light Switch

Part A: Investigate product problems at YOUR HOME

1. The locations of LIGHT SWITCHES are ideal for my needs at my home.
   - Strongly Disagree
   - Neutral
   - Disagree
   - Agree
   - Strongly Agree

2. The location of the WALL SOCKET is ideal for my needs at my home.
   - Strongly Disagree
   - Neutral
   - Disagree
   - Agree
   - Strongly Agree

3. It is difficult to find the LIGHT SWITCH in the dark sometimes at my home.
   - Strongly Disagree
   - Neutral
   - Disagree
   - Agree
   - Strongly Agree

4. It is difficult to access the WALL SOCKET to plug in or unplug from it at my home.
   - Strongly Disagree
   - Neutral
   - Disagree
   - Agree
   - Strongly Agree

5. It is difficult to access a SWITCH on the EXTENSION CORD to turn on/off it.
   - Strongly Disagree
   - Neutral
   - Disagree
   - Agree
   - Strongly Agree

6. Sometimes, I have difficulty turning on and off LIGHT SWITCHES.
   - Strongly Disagree
   - Neutral
   - Disagree
   - Agree
   - Strongly Agree

7. I am sometimes confused at which LIGHT SWITCH controls the light at home.
   - Strongly Disagree
   - Neutral
   - Disagree
   - Agree
   - Strongly Agree

8. It is IMPORTANT for me to unplug or shut down all electronic equipment before leaving my home.
   - Strongly Disagree
   - Neutral
   - Disagree
   - Agree
   - Strongly Agree

9. It is INCONVENIENT for me to unplug or shut down all electronic equipment before leaving my home, no matter I usually do that or not.
   - Strongly Disagree
   - Neutral
   - Disagree
   - Agree
   - Strongly Agree

10. It is inconvenient for me to change the location of LIGHT SWITCH with current products, such as the extension cord with switch or a LIGHT SWITCH on a wall.
    - Strongly Disagree
    - Neutral
    - Disagree
    - Agree
    - Strongly Agree

Part B: Solution Research

1. Which kind of LIGHT SWITCH do you prefer to use at home?
   - A. Toggle
   - B. Food Pad
   - C. Touch Sensor
   - D. Push Button
   - E. Dimmer

2. Where is the place that you need more WALL SOCKETS at home?
   - A. Living Room
   - B. Bedroom
   - C. Bathroom
   - D. Kitchen
   - E. Dining Room

3. Which feature of a LIGHT SWITCH do you benefit from when using it in the dark at home?
   - A. Large touching area on the switch
   - B. Extendable touching area of the switch
   - C. Clear visibility
   - D. The switch location can be adjustable
4. Which feature of a LIGHT SWITCH do you think can make your life more convenient at home? (multiple choice)

- [ ] A. Large touching area on the switch
- [ ] B. Extendable touching area of the switch
- [ ] C. Clear visibility
- [ ] D. The switch location can be adjustable
- [ ] E. Simple instruction
- [ ] F. Other

5. Which feature of an ELECTRICITY SWITCH product (such as extension cord with switch) do you think can facilitate turning it on/off safely and easily at home? (multiple choice)

- [ ] A. Large touching area on the switch
- [ ] B. Extendable touching area of the switch
- [ ] C. Clear visibility
- [ ] D. The switch location can be adjustable
- [ ] E. Simple instruction

6. What other features do you think can facilitate controlling ELECTRONIC EQUIPMENTS and use LIGHT SWITCHES?

---

**Significant finding from the survey:**

- **79%** of people think that **clearly visible** switches in the dark are important.

- **74%** of people prefer a **simple way** to actuate switches to complex interface or program operation.

- **71%** of people think that the **remote control** will make it easier to control wall outlets and the power strip.

- **53%** of people think that it is inconvenient for me to turn off, shut down or **unplug** electronic equipment before leaving my home.

- **50%** of people think that it is **difficult to get access** to the on/off switch on multi-outlet "power strips" that use.

Most people identify the following issues about the slight switch, outlet and power strips in their homes:

**For Switches:**

1. Users are confused by the content and interface of some switches at home.

2. The locations of some switches at home no longer fit their needs.

3. It is difficult and expensive to change the location of a switch by pulling wires.

4. Users have a hard time finding light switches in the dark.
For Outlets & Power Strips:

1. It is difficult to access some wall outlets or switches on power strips at home
2. They need to avoid certain objects or furniture to unplug electronic equipments.
3. For energy saving, they prefer to unplug electronics when they aren't used.
4. For security concern, they turn off the switches on power strips before leaving.

Design Opportunity:

Compile market research and users' survey to understand different aspects of product benefits and drawbacks to identify the ideal design elements. Users' behavior, expectations and current technology will be taken into consideration during the following ideation process.

Criteria for design objective

1. **Legible:** Emphasize on more intuitive hardware operation instead of instructed programming process.
2. **Visible:** Include LED indicator or luminous coating technology to allow more clear visibility in the dark.
3. **Compatible:** Increase the ability to fit current house décors, like duplex outlet, and electronics’ specifications.
4. **Customizable:** Create more flexibility to easily perform multiple tasks for different occasions or users’ desires.
5. **Memorize-able:** Include more characteristics on the interface to help users to memorize its content.
6.4 Metaphor Ideation

The metaphor approach in this project serves mainly to help the designer simplify the problems, develop meaningful concepts and create a new pleasurable experience from the product. In terms of user scenario and product system research, the metaphor concept of "nerve cellular system" is used to conceive a new solution. The intension of this metaphor is to add a playful value and organic connection to the product ideation.

All switches are a "nerve cellular system" and the new meaning is given to the switch as follows.

• The switch is a nerve system; the space is a living object
• To use the switch is to trigger the sense of the nerve system
• Installing a switch is to implant a nerve system within a body of a space
The correspondence between "switches" and "nerve cellular system" in metaphor are as follows:

a. Network connection

b. Capability to split and multiply: modular system

c. Free form and organic: customizable

6.5 Product Ideation

More product concepts are developed based on metaphor of "switch system is nerve cellular system."

Concept A: Programmable Wireless System

In this system, there is a central remote switch with multiple LED button, a wireless switch and a wireless outlet with prongs. Once the wireless device is paired with the remote switch, the LED color of the button on the remote switch will become the same as the LED color on the wireless device. The multiple LED button on the remote control allows expansion to more wireless devices. The central button on the remote switch dictates whether it is all on or all off.

Pros: Highly integrated and minimal interface design; color coding for easy identification

Cons: Fixed numbers and limited buttons in layout; need to program devices in advance

Concept B: Modular Remote System

In this system, there is a central remote controller, a set of wireless switches with a detachable remote switch and a set of wireless pronged outlet with it a detachable remote switch. This modular system allows the user to create a
customized remote controller by plugging multiple remote switches from different wireless devices into the central remote controller. Each set of wireless devices and remote switches share the same LED color. The magnet joint allows the user to rotate the remote switches on the central remote controller to create a certain form pattern.

**Pros:** Ability to be flexible; customized; and no program needed

**Cons:** The interface and the functionality of the switch are too confusing and not clear enough

---

**Concept C: Modular Remote System in Circular Pattern**

This modular system is similar to concept B, but the form and the interface are simplified and refined further. There is a central remote controller with on/off buttons on it, and a set of wireless switch and pronged outlet with its own detachable remote switch. Instead of color LED light, the luminous color coating is used for the same set of wireless device so the user can see them in dark. The form of the remote switch is in a circular pattern, which allows the user to customize the pattern of the remote switch with directional indication for easy identification and receiver location. The central remote controller and the wireless switch are expandable and interchangeable with other remote switches.

**Pros:** Both wall switches and remote switches can be customized and interchangeable

**Cons:** Need two buttons on both sides for one switch; the organically circular pattern may not fit home environments

---

**Concept D: Modular Remote System in Linear Pattern**

The system and the component of this concept are same as the concept C, but the form is dramatically different. All the components are in a block form factor. Therefore, once all the remote switches are ganged together, it will become a long square controller. It only allows growth from top or bottom and cannot form a circular pattern.

**Pros:** Simple and intuitive interface and strong affordance for users

**Cons:** Only linear layout for switch; less personalization value
Initial metaphor concept of nerve cellular system:
Concept A: Programmable Wireless System

- Central remote switch / transmitter with 5 programmable buttons
- Plug-in outlet receiver
- Wall switch + receiver
- Each control button with different LED light color
- Button with the same color LED light to control the corresponding device
Concept B: Modular Remote System

- Magnet joint makes switches rotate to any direction
- Central remote controller powered by batteries
- LED light: glow the same color within the same set
- Remote switch/transmitter
- Plug-in outlet receiver
- Light wall switch/receiver powered by DC power
Concept C: Modular Remote System in Circular Pattern

- Central remote controller (powered by batteries)
- Luminous color coding buttons
- Light wall switch (receiver) + remote switch (transmitter)
- Plug-in outlet (receiver) + remote switch (transmitter)
- Pin for joint
- Interchangeable
- Bottom with the same color LED light to control the corresponding device
Concept D: Modular Remote System in Linear Customized Pattern
6.6. Selected Concepts Evaluation

The mock-ups of Concept C and concept D are made in order to do a further evaluate and compare for final design direction.

<table>
<thead>
<tr>
<th>Modular Remote System in Circular Pattern</th>
<th>Modular Remote System in Linear Pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Image]</td>
<td>[Image]</td>
</tr>
</tbody>
</table>

There is a central remote controller with on/off buttons on it, a set of wireless switch and pronged outlet with its own detachable remote switch. The luminous color-coding indicates the set of the wireless device and its matching remote switch.

The connection joint is rotatable so the user can expand the pattern of the remote switch to different directions. It helps the user to memorize which remote control corresponds to which wireless device.

<table>
<thead>
<tr>
<th>1. Tangible metaphor approach:</th>
<th>1. Tangible metaphor approach:</th>
</tr>
</thead>
<tbody>
<tr>
<td>More clear association with organic or toy-like object</td>
<td>Less association to organic object; more industrial looking</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Behavioral metaphor approach:</th>
<th>2. Behavioral metaphor approach:</th>
</tr>
</thead>
<tbody>
<tr>
<td>The rotatable joint associate more playful experience</td>
<td>Only associate with building up a pile of blocks; less playful</td>
</tr>
</tbody>
</table>

| 3. Social metaphor approach: |  |
As it has a unique form, it is less universally recognizable.

**4. Reflective metaphor approach:**
Allow the user to create a personal meaning to the modular system by customizing the pattern in a flexible way.

**Pros:**
This modular system adds more playful value and personalization to the user experience.

**Cons:**
The user may need to learn how to use the system due to its unique form.

**3. Social metaphor approach:**
The modular system is more recognizable due to shared experience.

**4. Reflective metaphor approach:**
The modular system is less personalize-able and can only be set up in a singular linear pattern.

**Pros:**
This modular system is intuitive and easy to use since its form is understandable and recognizable.

**Cons:**
The connection method limits the user to create a personal meaning with the product creates a less playful experience.

Although the linear pattern concept is more recognizable and easier to understand, the benefits of being playful and personalize-able makes the circular pattern concept more valuable helps to create a more pleasurable user experience. Therefore, the Modular Remote System in Circular Pattern is selected for the final design.
6.7. Final Design: Cellular Switch System

Cellular Switch System: Multi-Connective, Customizable, Identifiable
Multi-Connective & Modular

• All remote switches are interchangeable among all devices without program need.
• Connect more different switches at the same place to create a networking control.
Customizable

- Use Central Remote Controller to expand and customize a gang of remote switches.
- Bond the switch layout to users' spatial metal mapping for switch locations reminding.

* Use a dock to mount it on the wall or just use it as a mobile remote anywhere!!
Identifiable

- The luminous coating allows users easily to find the switch in the dark.
- Color-coding & customizable layout help users memorize the switch content.
### PART3: CONCLUDING SECTION

#### 7. Conclusion

### 7.1 Comparison between existing products with improved products

**Timer Switch Solution:**

<table>
<thead>
<tr>
<th>Light Cather Pro</th>
<th>Leviton, Woods, Intermatic and Honeywell</th>
</tr>
</thead>
</table>

**Features:**
- + LED light motion and indication offer better legibility.
- + Semi-auto sensor function increase versatility of use.

**User Experience:**
- + Push and pull make adjustment more intuitive and flexible.
- + LED light allows the user to read time span and find it in dark.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
</table>

**Features:**
- - The interface always shows detailed information.
- - Multiple buttons and options offer many settings.

**User Experience:**
- - The control is complicated to use and lacks flexibility.
- - The user is easily confused by the overwhelming interface.

**Wireless Switch Solution:**

<table>
<thead>
<tr>
<th>Cellular Switch System</th>
<th>Heath Zenith, Woods, Belkin, GE and Lutron</th>
</tr>
</thead>
</table>


### Features:

+ The modular system allows the user to customize the control.
+ Luminous color-coding provides clear visibility and recognition.

### User Experience:

+ It is intuitive and flexible to change the control to fit one’s needs.
+ Playful and pleasurable value are added to in-use experience.

### Features:

- The wireless system requires a fixed programming process.
- It is programmable and expandable with multiple controls.

### User Experience:

- Complex channel setting and interface may confuse the user.
- The control cannot be adjusted for different uses; inflexible.

#### 7.2 Empirical and Qualitative User Testing and Feedbacks

User testing is conducted with the psychical prototypes by four different people. The testing concepts include Bottle Switch and Push and Pull switch from the timer switch project and Modular Remote System in Circular Pattern and in Linear Pattern from wireless switch project. This is a small-scaled empirical and qualitative sample testing and the goal of this testing is to aim at collecting user's feedback and preference for design direction. The participants are asked questions from the questionnaire and their reactions and expressions are observed. The following are the questions for each project. The whole session takes about 30 minutes for each participant.
Timer Switch Project: Bottle Switch and Push & Pull switch

1. What do you think this is? Why?
2. What do you feel about this product? (look, function and expectation)
3. What do you want to do with it at first sight? Why?

*Explain the product before going to the following questions*

4. What would you do to extend more time for the light? And reduce the time for the light?
5. Now please adjust the switch for 10 minutes time span, 30 second and 1 hour.
6. Where do you want to use this product at home? Why?
7. What is the feature that you like most and dislike most for this product? Why?
8. Does the metaphor in this product create advantages for you?
9. Now pick 1 product, which one would you pick? Why?

Wireless Switch Project: Modular Remote System in Circular Pattern and in Linear Pattern

1. What do you think this is? Why?
2. What do you feel about this product? (look, function and expectation)
3. What do you want to do with it at first sight? Why?

*Give a limited product instruction before going to the following questions*

4. What would you do to turn on the light?
5. What would you do to turn off the light?
6. What would you do to add more switches to this switch (wall light switch) to control other lights?
7. What is the way to keep you remember which button control witch light?
8. Now you have a central remote switch. What would you do to make it control other switches?
9. What is the way to keep you remember which button control witch light?
10. Where do you want to use this product at home? Why?
11. What is the feature that you like most and dislike most for this product? Why?
12. Compare the first concept and the second concept, which one do you prefer? Why?

**Process of the user testing:**

Part 1. Place the switch on the wall

➔ Ask how they feel about this product generally

➔ Ask how they want to interact with it
Part 2. Place the switch on the desk and explain how this product works briefly by showing rendering images.

➔ Ask them to perform the product function and observe how they do it.

➔ Ask how and where they will use this product at home.

➔ Ask which feature of the product they like and dislike.

Part 3. After the testing of two concepts from the same project, place two concept prototypes together on the desk.

➔ Ask which concept they prefer and why.

<table>
<thead>
<tr>
<th>Participant 1: Hui</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timer Switches</td>
</tr>
<tr>
<td><img src="image1" alt="Hui with Timer Switches" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Participant 2: John</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timer Switches</td>
</tr>
<tr>
<td><img src="image3" alt="John with Timer Switches" /></td>
</tr>
</tbody>
</table>
Participant 3: Anna

Timer Switches | Wireless Switches
---|---

Participants 4: Mike

Timer Switches | Wireless Switches
---|---

Result of the user testing:

<table>
<thead>
<tr>
<th>Timer Switch: Bottle Switch</th>
<th>Timer Switch: Push &amp; Pull</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Most people recognize it as a light switch and feel it looks like a mike bottle or a drinking container.</td>
<td>• Most people recognize it as a light switch and feel it looks like something that they can push or pull.</td>
</tr>
<tr>
<td>• Their first instinct is to try to slide it up and down.</td>
<td>• Their first instinct is to push, pull, turn or wiggle it</td>
</tr>
</tbody>
</table>
### Conclusion:

Most people prefer the push and pull switch concept than bottle concept because the push and pull concept allows them to control the light switch more intuitively and the metaphor in this design also create a meaningful interaction experience to help them to understand how this product works.

<table>
<thead>
<tr>
<th>Wireless Switch: Circular Pattern</th>
<th>Wireless Switch: Linear Pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most people recognize it as a light switch and feel it looks like a child’s toy because of its form and color</td>
<td>Most people recognize it as a light switch and feel it looks like a hi-tech and sleek device.</td>
</tr>
<tr>
<td>Their first instinct is to try touch the button.</td>
<td>Their first instinct is to try touch the button.</td>
</tr>
<tr>
<td>They can use the product correctly by detaching and connecting multiple remote switches.</td>
<td>They can use the product correctly by detaching and connecting multiple remote switches.</td>
</tr>
<tr>
<td>They want to use it in any room in the home.</td>
<td>They want to use it in any room in the home.</td>
</tr>
<tr>
<td>They like the color-coding, ergonomic form and the playful way one can customize the switches.</td>
<td>They like the color-coding, flat and clean form factor and the intuitive way one can customize the switches.</td>
</tr>
<tr>
<td>Some of them think the organic form makes it a little confusing to understand how it works in the beginning.</td>
<td>They think the big button and the consistent visual form helps them to understand how it works easily.</td>
</tr>
</tbody>
</table>
Conclusion:

Some people appreciate the playful and fun experience of customizing the switches, and some people appreciate the efficiency and legibility of assembling the switches. However, although most people can see the value of both concepts, they still prefer the linear pattern concept to the circular concept. While the circular concept can create more meaningful and fun experience, the linear concept can meet users’ need more in terms of usability practicality.

7.3 Values and Challenges of Experiential Metaphor Approach

The intension of metaphor application projects is to utilize the metaphor as an approach to shape the product design and create a better and more positive user experience. While the structure of cognitive metaphor is constituted by systematic correspondences, correlations in human's experiences and non-subjective similarity between two different conceptual domains, the emotional responses are formed from meaning association with experience, personal variations and self re-interpretation. Given common areas between cognitive metaphor and emotional response, the experiential metaphor is developed with an emphasis on individual experience, co-experience and cultural variation to interpret and indentify the meaning outside self.

The experiential metaphor is grounded in two emotion models: Pleasure approach to product emotion and Process-level approach to product emotion and forms four different types of metaphor approaches: 1. Tangible metaphor approach, 2. Behavioral metaphor approach, 3. Social metaphor approach and 4. Reflective metaphor approach. In addition, the studies of metaphor integration theory and metaphor as promotion to new design are taken into consideration on the design development process. The design process with the metaphor methodology and the user's reaction to the design concept driven by the metaphor approach are summarized as follows:
Experiential metaphor design process:

→ Create an archetype of metaphor concept based on user scenario
→ Define correspondences between two domains via meaning association
→ Expand more design concepts based on initial metaphor archetype
→ Refine and evaluate concepts based on design objectives or criteria

User's response to experiential metaphor design:

→ Interact with the product based on existing knowledge
→ Realize the functionality and features based on experience with the product
→ Correlate the value of the product to a use scenario or a past experience
→ Interpret the meaning of the product as it relates to their personal preferences and emotional responses

Values of Experiential Metaphor Approach:

From the design application process and user feedback, my research shows that experiential metaphor indeed creates influential results for both the designer and the users. For users, it not only makes it easier to learn how a new or more complicated product works, but it also provides users with an interactive way to interpret the meaning of a product, and thus inspire a meaningful experience. For the designer, experiential metaphor can be used not only as a method to expand concept ideation to develop a new meaning of a product, but also as a strategy to promote and communicate the meaningful values of a new product to the users or the consumers.

Regarding emotional aspects, most users tend to interact with a product first, consider its function, and then start to correlate it to their experiences, and develop interpretations and emotional responses. Self-interpretation and emotional responses are subject to how the (metaphor) meaning is related to their interaction with the product. If it is a meaningful and pleasant experience, and the positive emotional responses from the user are elicited.
Challenges: Meaningfulness versus User Experience

Based on user feedback, the experiential metaphor approach indeed can add meaningful values to the product design and elicit positive emotional responses. However, in some situations, the users will consider the use of the product and their needs holistically instead of the meaning of the product alone. Although meaning association in metaphor can serve as an approach to achieve a pleasurable product design, other factors, like usability, functionality and intuitiveness need to be taken into consideration equally to accommodate the full scope of the user's expectations. Therefore, the experiential metaphor approach, like other existing design methodologies, needs to be complemented with other methods and testing processes to achieve the best design.
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