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Shaping product form based on consumers' cognition

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ABSTRACT

In product design and development, it is important to investigate the true wants of target user group. Norman [1] suggested that the wants can be divided into three levels, namely, visceral level, behavioral level, and reflective level. Each level requires a different design. Among the three levels, reflective level refers to message, culture and self-image that transfer to the meaning of a product. Thus the point is how to catch the meaning of a product. This study uses the image schema method to identify the emotional response of the users when they watch the pictures of specific cultural content. Furthermore, this study extracts the design elements with strong emotional responses and applies to shape the form of product, hopefully to create attractive, sensitive, and cultural image products. A case study of new mobile phone shape design was conducted to verify the effectiveness of the proposed methodology.

Keywords: *Products form, cognition, Reflective design, image schema*

1 INTRODUCTION

The appearances and styles of products are mostly determined on the philosophy, aesthetics, life, and design experiences of designers. However, the personal experience and perception of product designers may not perfectly meet the requirements and preferences of consumers or users. Therefore, systematic investigations of consumers' requirements, expectations and cognition are important for product development. On one hand, researches of marketing and consumers' behavior along with product function analysis guide the directions of product architecture construction and product family design, on the other hand, cognition psychology, esthetics and product semantics provides theoretical basis for designers forming product appearances and details[1][2]. Chuang and Ma proposed a systematic survey method to reduce the perceptual gap between designers and usrs[1]. They indicated the methodology can provided insights into correspondence between product form and the mental feeling users may experience. McDonagh, Bruseberg and Haslam presented the qualitative techniques (product personality profiling, mood boards and visual product evaluation) to eliciting user perceptions and emotional responses to product though visual evaluation and stimuli. They

found Based on cognition psychology and experientialist theory[2]. This study constructed design elements through investigating consumers' cognition.

Heufler [4] indicates three basic functions of industrial products should be carefully involved by designer. There are practical functions, aesthetic functions, and symbolic functions. The practical functions are derived from that people experience the physical aspects of the product at the user level. Meanwhile, the aesthetic functions are derived from that people experience the sensory of the product at the observer level. Finally, the symbol functions are derived from that people experience the social aspects of the product at the owner level. Accordingly, Norman [1] based on emotion research, suggested that these human attributes result from three different levels of the brain, namely, visceral level, behavioral level, and reflective level. Each level requires a different design. Among the three levels, reflective level refers to message, culture and self-image that transfer to the meaning of a product. Thus the point is how to catch the meaning of a product. Rompay et al[3]based on the work of Lakoff and Johnson[4], suggested a hypothesis that repeated human bodily interactions of a similar kind lead to the formation of image schemas guiding our understanding of the expression of products.

Based on the above researches, this study conducted the reflective level design, and using the image schemas as a tool to understand users' cognitions, to identify the direction of design, and help designer to convey the design.

2 RESEARCH METHODOLOGY

This research was mainly divided into three phases. Phase I is the cognition investigations of the users. Phase II illustrates the methods of implementing form design. Phase III reviews the product forms.

2-1 The cognition investigations of the users

In product design and development, it is important to investigate the true wants of target user group. Norman [1] indicates that the user requirements can be realized to product characteristics as appearance, the pleasure and effectiveness of use, self-image, personal satisfaction, and memories. Thus, there is a need for designer to use systematic methods to investigate the cognition of user. Traditionally, designers use focus group, data mining, mood board etc., to deal with visceral design and behavioral design. This study concentrates on reflective design. We use the image schema method to identify the emotional response of the users when they watch the pictures of specific cultural content. Furthermore, we extract the design elements with strong emotional responses and apply to shape the form of product, hopefully to create attractive, sensitive, and cultural image products.

2-2 The methods of implementing form design

The investigation results of phase I are transformed into product form design. This stage studies the design methods of transformation. There are some form design methods, such as

analogy, metaphor, scenario etc. In which, analogy method is the most intuitive, easy to use, and recallable for designers. Practically, the engineering specifications are probably fixed, resulting the form design is limited. Thus a limited analogy method can be derived from absolutely analogy method. Following case study, the limited analogy method is chose to apply for this research purpose.

2-3 Inspection of the product forms

The Inspection of the product forms is a feedback process. Designers can use the evaluations of users to self-examine and improve their design skill. Moreover, the true wants of users can be explored, evolved product with reflective design. This study applies a questionnaire method to evaluate the form designs and inquiry perceptions of the target group. The purpose is to help designers to understand whether the design method is proper to be applied to the product.

The proposed methodology conforms to Norman's Conceptual Models (Figure 1). For someone to enjoy a product satisfactorily, they must form the same mental model (the user's model) as that of the designer (the designer's model). The entire communication takes place through the "system image": the information conveyed by the physical product itself (Norman, 2004). But the designer only talks to the user via the product itself, it is hard to match the cognition of user. Thus, this study starts at identifying user's cognition. Then the designers interpret the cognition and transform into the physical design. Furthermore, the design is used to analysis the perceptions of the user (Figure 2). Therefore, in the process the designer adjusts his/her conceptual model and enhance his/her design ability to know well of user's cognition. As Norman [1] suggested："A good designer will make sure that the system image of the final design conveys the proper user model. The only way to find this out is through testing: develop early prototypes, and then watch as people try to use them."

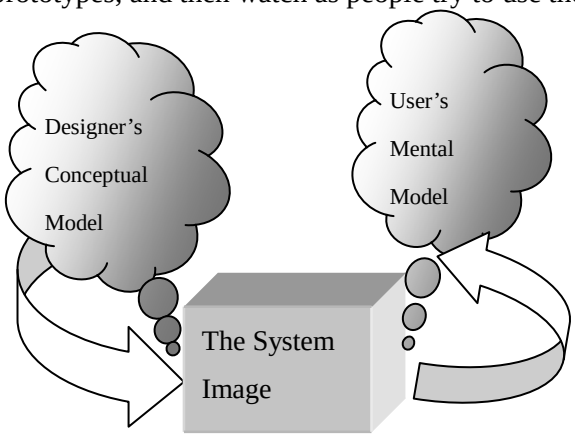


Figure 1 Conceptual Models

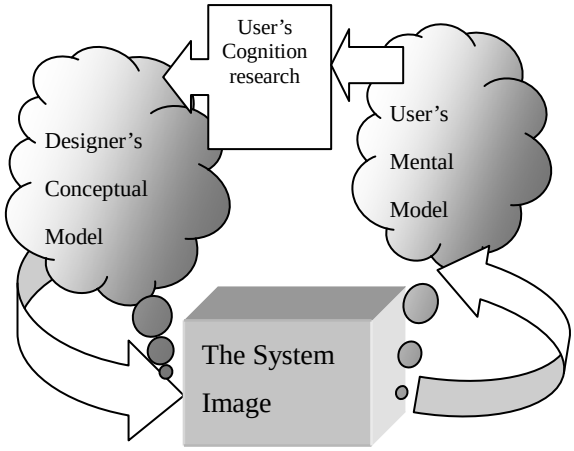


Figure 2 Research Models

3 CASE STUDY

The feasibility of the proposed methodology is verified via a case study of mobile phone design, owing to the rapid development, shortened product life cycle, rich user's operation experiences, and variable shapes of the product. To simplify study parameters, the shape of product is major concern; the color, material, surface and texture are not involved in this case study.

3-1 The cognition investigations of the users

This study applies limited analogy design method via using the pictures of Chinese cultural content. To allow proper transformation design, the variance of the reference pictures should be as large as possible. By applying Muller's [5] typological classification system that describes form categories encompassing the whole range of form differentiation. Twenty one pictures are selected with the effort of trying to guarantee maximum variation in the expressions judged [6] (Figure 3). All pictures are line drawing and Chinese antiques of chairs, bottles, tables, window frames, cups, landscape painting, and facial makeup in Chinese opera. Participants were 132 college students (age range 20-25). They have experiences of using mobile phones for 5.8 years, and consumed 4.9 mobile phones in average. They rated on 5-point bi-polar scales measuring the impression of mobile phone shapes. The average score is 3.381, and the standard deviation is 0.71, indicating that they are somewhat satisfied of their current mobile phones. In the rating of culture pictures, the most popular expressions are 6, 7, 18 (Table 1).

3-2 Shaping Product forms

In this case, the engineering specifications of monitor size and number of keys are assumed to be fixed. Thus, the limited analogy method was applied to design the three new shapes of

mobile phones (Figure 4).

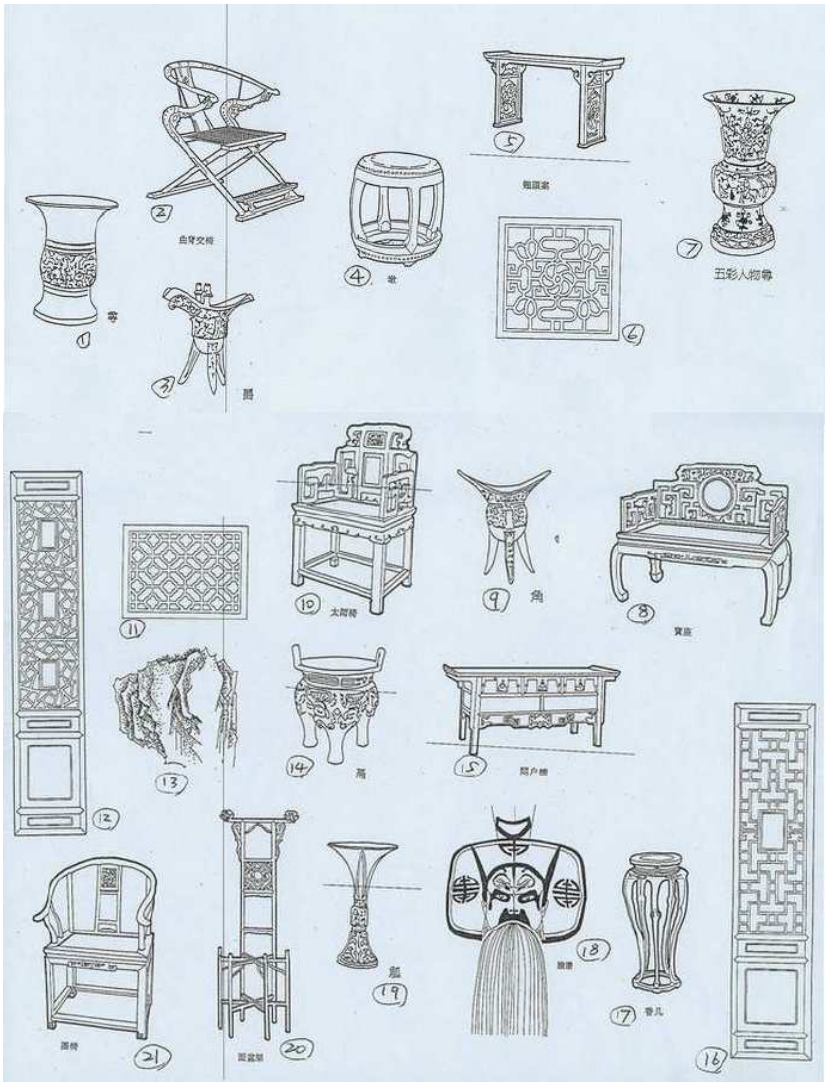
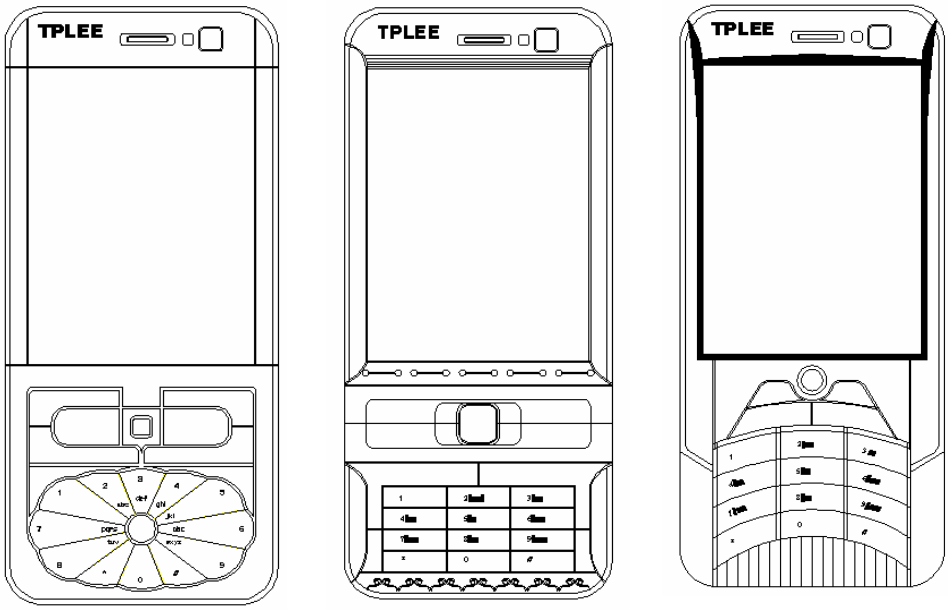


Figure 3. The pictures of Chinese cultural content

Table 1 The rating of culture pictures

No.	Ratings	percentage	No.	Ratings	percentage
6	46	34.3%	19	13	9.7%
7	45	33.6%	13	12	9.0%
18	34	25.4%	20	11	8.2%
11	32	23.9%	17	10	7.5%
2	30	22.4%	10	9	6.7%
8	27	20.1%	5	8	6.0%
4	25	18.7%	1	7	5.2%
12	22	16.4%	14	6	4.5%
3	17	12.7%	15	4	3.0%
16	17	12.7%	21	3	2.2%
9	14	10.4%			



Shape 1(reference picture 6) Shape 2(reference picture 7) Shape 3(reference picture 18)

Figure 4 Mobile phone shape design

3-3 Inspection of the product forms

The three new shapes of mobile phones were presented to the same participants who conducted cognition investigation questionnaires.

They rated on 5-point bi-polar scales measuring the originality, association (associative ability to the reference pictures), and satisfaction of the new mobile phone shapes. The result is illustrated In Table 2, the shape 1 scores highest in originality and satisfaction while the shape 3 provides the strongest association to the reference picture. Furthermore, we conducted one way ANOVA, and correlation analysis to thorough inspection.

Table 2 Shape Descriptive statistics

		originality	associational	satisfactorily
Shape1	Mean	2.2421	2.2947	3.5263
	Std Dev	0.6477	0.5433	0.7122
Shape 2	Mean	1.4105	1.9053	3.1053
	Std Dev	0.6273	0.6853	0.6856
Shape 3	Mean	1.9789	2.4421	3.2211
	Std Dev	0.7716	0.6477	0.7743

In case study, One way ANOVA is applied to verify the differences among the three new shape designs (Table 3). There are obviously differences on originality, association, and satisfaction.

Table 4 illustrates the correlation analysis, originality has higher correlation with association,

and the following is the correlation between association and satisfaction. But it also indicate that some factors remain unknown, resulting the low explanation ability. The results implied that some factors have to be involved in future research.

Table 3 One way ANOVA

ANOVA	F value	Pr>F
originality	36.558	0.000**
associational	18.514	0.000**
satisfactorily	6.789	0.001**

Table 4 Correlation analysis

Pearson Correlation	originality	associational	satisfactorily
originality	1		
associational	0.390**	1	
satisfactorily	0.303**	0.368**	1

** Correlation is significant at the 0.01 level (2-tailed).

According to the above analysis results, the designer verifies the design skill and expands the understanding with the user need, desires, and aspirations. For example, the shape 1 scores highest in originality and satisfaction. The results provide valuable insights for the product developer to help knowledge and understanding of the users' need.

4 DISCUSSIONS AND CONCLUSIONS

This study presents a systematic approach aiming at reflective design. The major objective of this approach is to establish an effective product form design methodology that can fulfill user's wants, enhanced design ability, and improve design quality.

As to traditional approach, which is mainly focused on designer conceptual model, design solution cannot properly match the user mental model. In addition, the redesign process fails to inherit previous experience and consumes huge resource. On the contrary, this study uses image schema and survey method to investigate user wants according to users' cognition, which aims at seeking design direction. The proposed systematic methodology is, further, introduced to obtain the proper design solution. It is also a useful method for inexperienced designer to improve their design skill. Now is an internet era, user can easily express their desires through the webs, on the other hand, designer also can observe consumer behavior. Through data warehouse and data mining techniques, designer can found niche market and design niche product to fit the true wants. Thus, this study, further, can be extended and used the internet superiority.

Through statistics analysis in section 3.3, the proposed methodology can improve the user satisfaction on the new shape designs. It is also can realize the iteration testing concept

suggested by Norman. This study is a primary product shape experiment; further research can extend to color arrangements, textures, operations, design methods, and other relative factors.

References

[1] Chuang M.C. and Ma Y.C. Expressing the expected product images in product design of micro-electronic products, *International Journal of Industrial Ergonomics*, 2001, 27, pp.233-245

[2] McDonagh D. Bruseberg A. and Haslam C. Visual product evaluation: exploring users' emotional relationships with products, *Applied Ergonomics*, 2002, 33, pp. 231-240

[3] Norman D. A. *Emotional Design*., 2004 (Basic Books)

[4] Heufler G. *Design Basics: From Ideas to Product*, 2004, (Verlag Niggli AG)

[5] van Rompay T. Hellert P. and Muller W. The bodily basis of product experience. *Design Studies*, 2005, 26, pp.359-377.

[6] Lakoff G. and Johnson M. *Philosophy in The Flesh, The Embodied Mind and Its Challenge to Western Thought*, 1999, (Basic Books, New York)

[7] Muller W. Order and Meaning in Design, 1999, (Lemma BV, Utrecht, The Netherlands)

[8] Zhang Y.M. Yang C. S. *Interior Graphics Standard*, 1994, (Architecture & Culture Publishing Co.,Ltd, Taiwan)

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