

A PROPOSED QUANTITATIVE UX ANALYSIS METHOD BASED ON A PSYCHOMETRIC QUESTIONNAIRE SURVEY

Yuka SUGIYAMA^{*a}, Toshikazu KATO^b and Takashi SAKAMOTO^c

^a Graduate School of Chuo University, Japan, a17.y5g4@g.chuo-u.ac.jp

^b Chuo University, Japan, t-kato@kc.chuo-u.ac.jp

^c National Institute of Advanced Industrial Science and Technology, Japan, takashi-sakamoto@aist.go.jp

ABSTRACT

In recent years, the User Experience or (UX) has become an important element in product design, including affective engineering as well as marketing. The UX analysis is typically driven by qualitative methods such as customer journey maps. On the other hand, the number of quantitative data analysis methods involved, such as multivariate analysis, is comparatively less. Therefore, the purpose of this study was to propose a UX data analysis method. It has been reported that the UX can be divided into the time spans of anticipated UX (before usage), momentary UX (during usage), episodic UX (after usage), and cumulative UX (over time). In this study, an analysis method focused on the time span of the anticipated UX imaging experience before usage is suggested. In this time span and since users may recall previous experiences and usage episodes, a psychometric method based on an uncertain experience is proposed. As a method of analysis, a psychometric questionnaire survey using product samples and two sets of evaluation terms with pragmatic and hedonic attributes were conducted according to the pragmatic/hedonic UX model proposed by Hassenzahl (2008). In addition to that, a Customer Satisfaction (CS) analysis is used to enhance users' satisfaction of the UX. The evaluation terms that greatly improved the pragmatic and hedonic attributes using this analysis were extracted. Moreover, rough sets were used to extract concrete morphological elements that comprised of

* Corresponding author.

the knowledge of design from the evaluation terms. As a portfolio map (x-axis: importance, y-axis: satisfaction) can be obtained from a CS analysis where each company's sample positioning can also be analysed. Therefore, the evaluation terms for enhancing each company's UX were clarified. A case study is conducted to confirm the effectiveness of the proposed method. Specifically, a questionnaire survey with 37 female office workers in their 30s were selected as subjects. The questionnaire included 60 sample photographs of bags downloaded from a mail order site and the evaluation terms consists of six pragmatic attributes and six hedonic attributes that were obtained using the laddering technique. The abovementioned analyses were conducted on the data obtained from the survey to confirm the effectiveness of the proposed method.

Keywords: *User Experience, Product Design, Rough Sets*

1. BACKGROUND AND PURPOSE OF THE STUDY

In recent years, the User Experience (UX) has become more important not only in product design, including Kansei engineering, but also in marketing. Hassenzahl and Tractinsky (2006) have proposed the UX as "a consequence of a user's internal state that includes predispositions, expectations, needs, motivation and mood. The characteristics of the designed system like complexity, purpose, usability and functionality and the context or the environment within which the interaction occurs either in an organisation or a social setting, the meaningfulness of the activity, voluntariness of use". [1]

The UX is a broad concept. The method of evaluating the UX involves several qualitative investigations such as the customer journey map and persona scenario methods. However, quantitative methods based on data analysis methods such as multivariate analysis have not yet been established. Therefore, a UX data analysis method in the present study is proposed.

2. DATA ANALYSIS METHOD

In the UX White Paper (2010) [2], it was reported that the UX involves four usage periods which are identified as *Before Usage*, *During Usage*, *After Usage*, and *Over Time*. In the present study, an analysis method for the anticipated UX period is proposed which entails the imagination of the experience before the first use. In this period, since users rely on past memory and experience as a reasoning, a psychometric method of "∼ so," is devised which is presumed from uncertain evidence.

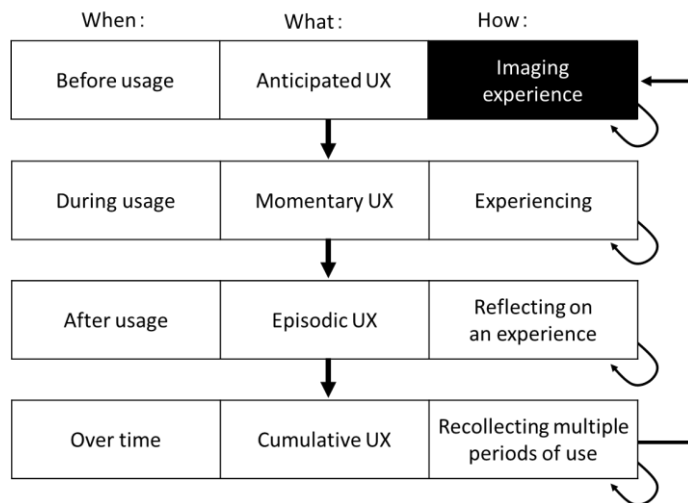


Fig. 1 Time spans of user experience

The study uses pragmatic and hedonic qualities, which were included in Hassenzahl's (2008) definition of the UX, as the evaluation items of the questionnaire. A psychometric method to conduct the questionnaire survey is used in the evaluation items and a product sample. Furthermore, in order to increase user satisfaction, which is an important element of the UX, the analysis included the Customer Satisfaction (CS) analysis. The CS analysis enabled the extraction of evaluation terms that contribute substantially to the realisation of pragmatic and hedonic qualities. Subsequently, using the rough set, the specific form factors that constitute the knowledge of the design from the evaluation terms were extracted. This portfolio map (x-axis: importance, y-axis: satisfaction) obtained from the CS analysis, enabled the study to analyse each company's sample positioning. In other words, it could clearly identify the evaluation terms that improve each company's UX.

3. CASE STUDY VALIDATION

In order to confirm the effectiveness of this proposed method, a case study was conducted on female bag design.

3.1. Questionnaire survey

First, a keyword search for "Commuter female A4" on major e-commerce (EC) sites (Amazon, Belle Maison Net, and ZOZO Town) were conducted. Then, similar samples were deleted and 60 samples of bags identified.

Subsequently, a laddering survey using 6 female college students that consists of 5 undergraduates and 1 graduate student was conducted. Then, cognitive sites were extracted and 13 evaluation terms were derived.

After extracting the cognitive site, 40 pragmatic qualities were classified into 13 items, and 36 hedonic qualities were classified into 9 items.

The evaluation terms used for pragmatic qualities were ; this bag seems to be "easy to take things out," "durable," "light-weighted," "ability to hold without fatigue," "easy to tidy things up," "easy to hold," and "easy to use."

Additionally, hedonic qualities such as this bag seems to be..."making a favourable impression," "inducing a sense of attachment, " "sophisticated," "good quality," "eye-catching," and "inducing a sense of fun." These qualities were all rated using a 5-point scale. The traditional semantic differential scale method uses opposite words, but the Kansei Engineering method often uses negative words. Therefore, in the present study, expressions such as "it seems to be ..." is used in order to enable the participants to infer from their memory and answer easily.

The Fig. 2 demonstrates pragmatic and hedonic attributes.

Pragmatic attributes	Hedonic attributes
This bag seems to be ...	This bag seems to be ...
light-weighted	sophisticated
easy to hold	inducing a sense of attachment
easy to tidy things up	making a favorable impression
durable	good quality
holdable without fatigue	eye-catching
easy to take things out	inducing a sense of fun

Fig. 2 Pragmatic and hedonic attributes

The details of the questionnaire survey are as follows:

- 1) Implementation date: October 2016
- 2) Participants: 37 people (Female, office workers, in their 30s, living in or near Tokyo prefecture)
- 3) Method: Internet survey with items comprising of a 5-point rating scale
- 4) Sample: Sample pictures from EC sites; 60 photos of bags
- 5) Evaluation terms: 13 adjectives

3.2. Customer satisfaction analysis

As the UX gives emphasis towards the viewpoint of satisfaction, the concept of CS portfolio is applied and shown in Fig. 3 in the proposed analysis. This concept is able to highlight the needs for improvement by clarifying the customers' priority items. It can identify the "maintenance items," "Improvement items," and "Priority improvement items." Thus, a CS portfolio can be used to improve satisfaction by focusing on the "priority improvement areas" (Fig. 3).

The proposed analysis method statistically calculates the strength of influence of the comprehensive evaluation, with "level of satisfaction" on the y-axis and "degree of importance" of each evaluation item on the x-axis. The extracted evaluation items with high improvement priority have been shown in Fig. 3.

In this study, the partial correlation coefficient was used to assess the degree of importance of each evaluation item. Additionally, the average value on the 5-point rating was used as an indicator of the level of satisfaction.

Objective variables such as "easy to use" for practical attributes, and "inducing a sense of fun" for emotional attributes are used.

The circle in Fig. 3 shows the result that is placed in the map of the CS portfolio. The triangle is an example of the result of the positioning analysis of the product.

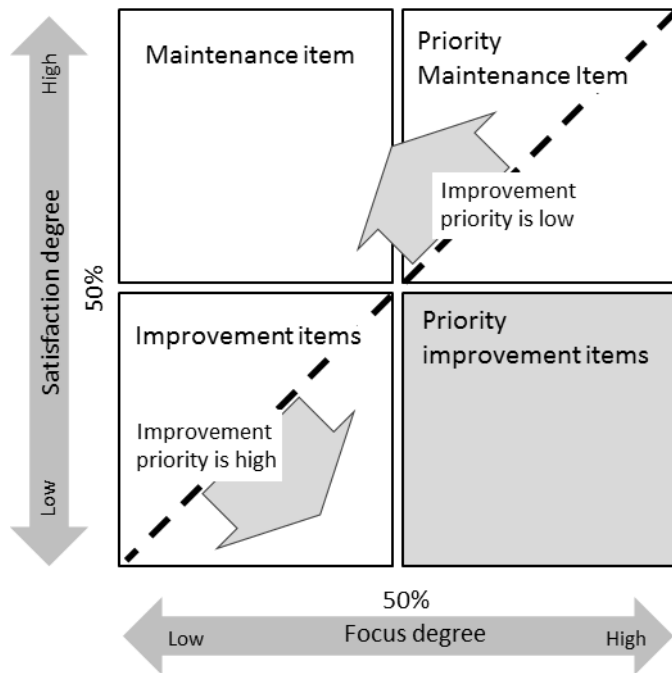


Fig. 3 Outline of the customer satisfaction portfolio analysis

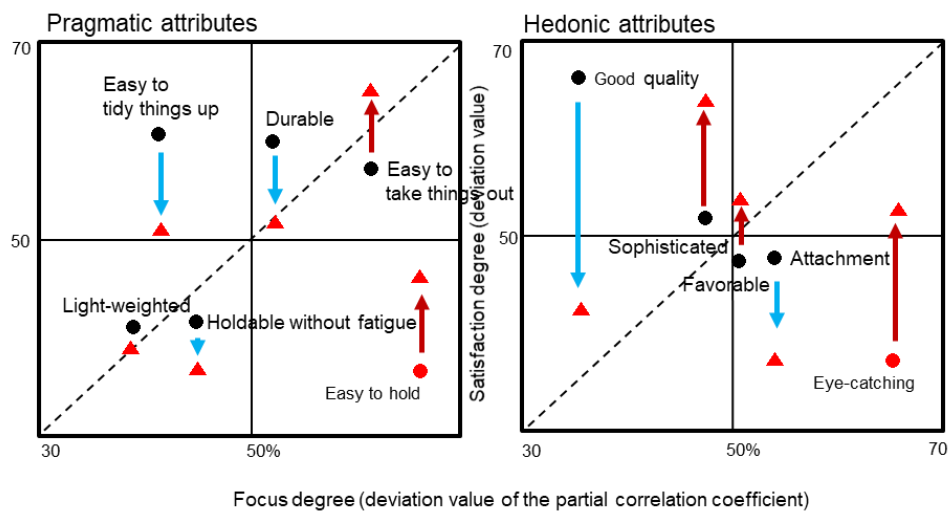


Fig. 4 Customer satisfaction placement and positioning based on the analysis results (Sample 8)

3.3. Analysis result consideration

As shown in Fig. 4, among the practical attributes, "easy to hold" was a "priority improvement item." In terms of emotional attributes, the item "prioritise" had the highest priority, "making a favourable impression" and "it seems to have an attachment " were identified as "priority improvement items." That is, for these items, although the degree of importance was high, the satisfaction level was lower than that for other items.

However, this result does not reveal concrete measures that each company should take to improve the UX. Therefore, a positioning analysis was conducted for each company. For instance, the triangle on Fig. 4 shows the positioning analysis for the company of Sample 8 (hereinafter referred to as Company A). The degree of importance is the same, and the degree of satisfaction is plotted using the average value of Company A. The findings reveal that the evaluation of Company A's "easy to hold" characteristic was among the pragmatic qualities that is higher than the average of the other companies, but it is also a "priority improvement item." This indicates that further improvement in this characteristic needs to be achieved.

On the other hand, among the emotional attributes, the highest priority was observed for "it seems to attract attention," which indicates a relatively high degree of satisfaction. However, the score for "it seems to have an attachment" was considerably lower than that of the other companies. These findings indicate that the company could employ a strategy for improving "it seems to attract attention" by making "it seems to have an attachment" the top priority improvement item.

However, a concrete method to obtain the design knowledge that contributes to these images is to determine the priority improvement items as decision classes (object variables) by calculation of a rough set.

A part of these results have been shown in Table 1. The middle and small classifications in the table were extracted based on the results of the laddering method.

Table 1 Summary of the rough set results

Pragmatic attributes		It looks easy to use		Hedonic attribute		It seems to be eye-catching		
		+	−			+	−	
Length of handle	Long	1.10	2.10	Image	Round	0.86	1.04	
	Short				Intermediate	1.03		
	Intermediate				Angular			
Thickness of handle	Thick	0.98	1.58	Material	It looks soft	0.74	0.78	
	Thin				Intermediate			
	Intermediate				It looks hard			
Number of handles	One	1.26		Surface treatment	Gloss	1.88	1.76	
	Two				Intermediate			
How to hold	Shawl only		2.19	Metal fittings	Matte	0.86	0.85	
	Shoulder				With simple metal fittings			0.78
	Both WAY				With decorative brackets			
Metal fittings	Present	0.75			None	1.71	1.17	
	None				Present			
How to fasten	Fastener	1.58	1.05	Outer pocket	None	1.03	1.43	
	Magnet / Button				Long			
	Purse			Length of handle	Short	1.95		
	None				Intermediate			
	Other				Black			
Inside pocket	Present	0.82	0.79	Color (main)	Gray	0.34	0.39	
	None				Brown system	1.03		
Outer pocket	Present		0.79		Beige	0.34		
	None				White system			
Bag thickness	Present	1.90	1.58		Red type	0.34		
	None				Blue series	0.68		
Form	Rectangle	0.82	1.05		Other			
	Inverted trapezoid		Color (sub)	Black	0.34	0.98		
	Trapezoid			Gray				
	Hexagon			Brown system				
	Vertical / Horizontal			Round	Beige			
Vertical				2.28			Blue series	0.34
Horizontal							Other	
Square	None						0.34	
Independent style	Self-supporting type	0.96	0.73	Color	Clear color			
	I can not stand it				Chic color			
Material	Leather					Pale colour		
	Nylon							
	Other							
	Using different materials							

It is evident from Table 1, having a long handle was evaluated positively for "easy to hold," and having a thick handle was evaluated negatively.

For the number of handles, two handles were evaluated positively, and the reverse trapezium evaluated more positively as compared to the trapezoid. Further, it seems that colours other than

black, glossy surface, and round shape were evaluated positively with reference to the attribute “It seems to attract attention.”

Table 1 also provides information on knowledge of design, which can be used to develop higher UX products.

3.4. Acknowledgments

The authors wish to thank Dr. Inoue, Professor at Hiroshima International University, for supporting the analysis and reviewing the results of this study.

REFERENCES

- Hassenzahl, M., & Tractinsky, N. (2006). User experience-A research agenda. *Behavior & Information Technology*, 25(2), pp. 91-97.
- Virpi, R., Effie, Law., Arnold, V., & Jettie, H. (2011). User experience white paper. <http://www.allaboutux.org/files/UX-WhitePaper.pdf>(accessed 12-12-2017).
- Inoue, K. (2009). *Application of rough sets to affective engineering*. pp. 36-38, Kaibundo.
- Ogilvy, J. A. (1985). *The experience industry, SRI international business intelligence program*. Report No. 724.
- Joseph, B., Pine, II. & Gilmore, J. H. (2011). *Experience economy*. Diamond Inc.
- Schmitt, B. H. (2000). *Experiential marketing*. Free Press.
- Wada, M. (2002). *Brand Value Co-creation*. Doubunkan.
- Pawlak, Z. (1982). Rough sets. *International Journal of Information Computer Science*, 11(5), pp. 341-356.
- Mori, T., Tanaka, H., & Inoue, K. (2006). *Rough set and affective engineering*. Kainbundo.
- Inoue, K. & Hirokawa, M. (2003). Proposal of related analysis between Kansei words and cognitive form. *Bulletin of International Rough Set Society*, 7(1/2), pp. 55-59.
- Sekiguchi, A., Inoue, K., & Uenakada, A. (2010). Proposal for method of design evaluation by variable precision rough set. *Journal of Japan Society of Kansei Engineering*, Vol. 9, No. 4, pp. 675-685.
- Pawlak, Z. (1982). Rough sets. *International Journal of Information Computer Science*, 11(5), pp. 341-356.

Hassenzahl, M. (2004) . The interplay of beauty, goodness, and usability in interactive products. *ACM Human-Computer Interaction* 19, p.319-349

Hassenzahl, M. (2010) . *Experience design-technology for all the right reasons*. Morgan & Claypool

Yamazaki, K., Matsubara, H., & Takeuchi, K. (2016). *Human centered design*. pp. 67 Kindaikagaku.