Research on Dishwasher with User Experience Evaluation

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Abstract. Dishwasher was introduced into China at the end of 80s, but was rarely known or used by Chinese families. In the past, there are rarely few user experience researches about dishwashers. This study developed a user experience evaluation based on task scenarios for three types of dishwashers, aimed at exploiting some suitable design ideas and suggestions in the evaluation for dishwasher localization.

Keywords: User experience evaluation · Task scenario · Dishwashers Design

1 Introduction

Dishwasher originated in Europe and was introduced into China at the end of 80s. However, at present, dishwasher coverage hasn't reached 3% in cities of China after decades. Washing dishes and tableware is a tedious, time-consuming and costly work due to the different types of greasy dirt according to the Chinese eating habits. Dishwasher can reduce lots of washing work in kitchens but why can't it be widely accepted by domestic consumers with such good help?

Sun et al. [1], Yue [2], Long [3] et al., studied the development of dishwasher in China, and pointed out that the reasons restricting the popularization of dishwasher in Chinese family various in high price, power consumption, water consumption, mismatching with Chinese tableware and Chinese habits etc. How can dishwasher really solve the pain point of Chinese users' demand and be accepted by Chinese consumers, is the main difficulty of localization design of dishwasher in China. At present, the research on dishwasher abroad mainly focuses on the energy consumption, cleaning and detergent safety. And there is not much academic research on dishwashers in China, mostly focused on three aspects on washing mode, structure and energy consumption. Localization of dishwasher needs to study the Chinese consumer's habits and cognitive logics and also the various types of greasy dirt and tableware in Chinese kitchens. Therefore, according to the dishwasher application and development at home, we developed the user experience evaluation on three dishwashers on China market.

User Experience reflects the perception and subjective feeling when using a product. User experience can be quantified and illustrated with examples base on usability [4]. While user experience refers to the specify feeling a person in the specify

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circumstance, the evaluation should be implemented in specify scenarios. The sequential task scenarios were launched including locating plate and bowls, operating dishwashers' interface, washing, fetching plate and bowls, and cleaning the dishwashers and so on. We concerned three aspects of the dishwashers, structure and component design, user interaction interface design, and cleaning and maintain design. And we observed and recoded the effectiveness, efficiency, satisfaction complied to ISO 9241 through all task scenarios. Besides, a post-Test interview was applied after the evaluation. This study aimed at exploiting some suitable design ideas and suggestions in the evaluation for dishwasher localization.

2 User Experience Evaluation Based on Task Scenarios

To explore the factors that affect the comfort of the dishwashers and the potential problems in the design of the current dishwasher products, three types of dishwashers were chosen, with different brands but same capacity. The sequential task scenarios were carried out, which are shown in the following table (see Table 1).

Table 1. The sequential of the task scenarios

Serials number	Task scenarios	Usability design concerned	Observed and recoded contents
a	Open the dishwasher	Structure and component design	Usability (effectiveness, efficiency, satisfaction)
b	Locate plates and bowls		
c	Fill in detergents and slats		
d	Detergents' gear setting		
e	Close the dishwasher		
f	Choose suitable functions and operate	User interaction interface design	
g	Dishes and bowls washing		
h	Open dishwasher while finished	Structure and component design	
i	Fetch the dishes and bowls		
j	Clean the dishwasher	Cleaning and maintain design	

2.1 Evaluation Environment

The evaluation was carried out in a kitchen-similar environment with basin. The three types of dishwashers were installed on the same surface. To avoid the experimental bias, the brand identity of the products was covered. The pollution be brushed on each plate and bowl was the same quantity with fixed proportion of cooking oils, soy sauce, salt, sugar, vinegar etc. which simulated the cooking habits of ordinary Chinese families. And the polluted dishes were boiled and stayed cool for a same time before being brushed (Fig. 1).

Fig. 1. The environment of the evaluation

2.2 Target Users and Procedures

A total of 12 participants (6 females, 6 males) involved in the evaluation. To cover the broader population characteristics, the participants were of three types, users who already have a dishwasher and use it regularly, users who have known about and want to buy a dishwasher, users who have non-knowledge of dishwashers.

Before the evaluation, users were told about the whole procedure. And 6 sets of tableware were polluted. The users were asked to complete the sequential of the tasks of usability test. Three contents were recorded including effectiveness, efficiency, satisfaction, and a post-Test interview was applied to each user after the evaluation, respectively.

2.3 Data Analysis

Through the evaluation, effectiveness, efficiency and satisfaction were recorded. A repeated ANOVA were used for statistical analysis. SPSS (16.0 J, SPSS Inc.) was used for calculation.

3 Results

The following is the result of subjective and objective measurement we obtained in the evaluation. We will dissect the evaluation results in three parts to explore the potential problems of dishwasher design of the dishwashers: structure and component design, user interaction interface design and cleaning and maintain design.

3.1 The Result of the Structure and Component Design of the Three Types of Dishwashers

The usability for structure and component design will be shown in two task scenarios, one is the tableware placing and fetching (scenario b and i, see Table 1), the other is detergents and slats filling and gear setting (scenario c and d, see Table 1). The

effectiveness, efficiency and satisfaction were recorded and analyzed, the typical tasks' results which can indicate the main problems of the design are shown in Figs. 2 and 3. It can be inferred from the figures that the average typical tasks' data are various of different dishwasher types. The repeated measure ANOVA shows significant main effects of different dishwasher type (F placing (2,22) = 3.586, P = 0.045 < 0.05, Fdetergents' gear (2,22) = 5.296, P = 0.013 < 0.05) on the three task scenarios specifying in tableware placing, detergents' gear setting, but no significant main effects on tableware fetching and detergents filling.

Further, the LSD post hoc test results (see Tables 2 and 3) showed that the tableware placing in dishwasher B is more convenient than dishwasher A and C, detergents' gear setting in dishwasher C is much simpler and easier understanding than dishwasher A and B.

In the post interview, participants pointed out that dishwasher A and C are foreign brand, and the internal structure is designed by European style. 66.67% users feedback the interior space design is not reasonable (such as the lack of specialized support), low utilization rate, and does not comply with the use of Chinese kitchen utensils. But dishwasher C's detergents' gear set is designed well for easy known, while the design on dishwasher A and B is concealed on the user interaction interface which is hard to find and learn.

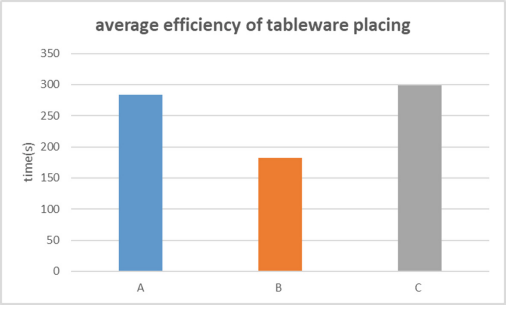

Fig. 2. The average efficiency of tableware placing of the three dishwashers

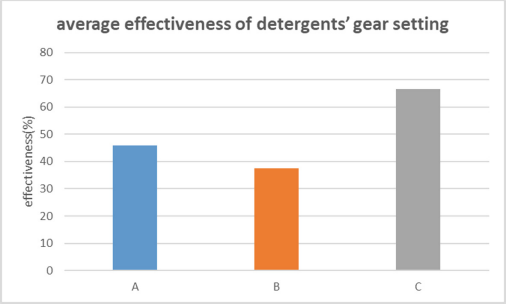

Fig. 3. The average effectiveness of detergents' gear setting of the three dishwashers

Table 2. Results of the LSD post hoc test on the average efficiency of tableware placing

Dishwasher type	LSD post hoc test result (placing)	
	Std. error	Sig.
A vs. B	36.111	.017*
C vs. B	45.645	.026*
A vs. C	58.187	.794

Table 3. Results of the LSD post hoc test on the average effectiveness of detergents' gear setting

Dishwasher type	LSD post hoc test result	
	Std. error	Sig.
A vs. B	.083	.339
C vs. B	.074	.017*
A vs. C	.114	.027*

3.2 The Result of the User Interaction Interface Design for Three Dishwashers

The usability for user interaction interface design will be shown in the program setting (scenario f, see Table 1). The effectiveness, efficiency and satisfaction were recorded and analyzed, the results which can indicate the main problems of the design are shown in Fig. 4. It can be inferred from the figures that the program setting task's data are various of different dishwasher types. The repeated measure ANOVA shows significant main effects of different dishwasher types ($F(2,22) = 3.878$, $P = 0.036 < 0.05$). Further, the LSD post hoc test results (see Table 4) showed that program setting in dishwasher C is much simpler and easier understanding than dishwasher A and B.

In the post interview, participants pointed out that the terminology of interaction interface on dishwasher A which is foreign brand uses literal translation cause highly misunderstanding and maloperation. And the operation logic is not consistent with Chinese cognitive habits due to unsatisfactory and dislike.

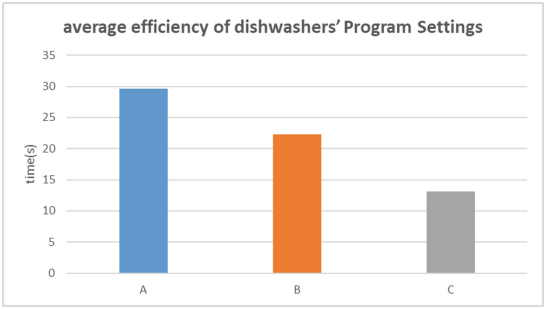

Fig. 4. The average efficiency of dishwashers' program settings

Table 4. Results of the LSD post hoc test on the average efficiency of dishwashers' program settings

Dishwasher type	LSD post hoc test result	
	Std. error	Sig.
A vs. B	7.342	.345
C vs. B	6.159	.021*
A vs. C	3.738	.031*

3.3 The Result of the Cleaning and Maintain Design for Three Dishwashers

The usability for cleaning and maintain design will be shown in cleaning the dishwasher (scenario j, see Table 1). The effectiveness, efficiency and satisfaction were recorded and analyzed, the results which can indicate the main problems of the design are shown in Fig. 5. It can be inferred from the figures that the average data are various of different dishwasher types. The repeated measure ANOVA shows significant main effects of different dishwasher types ($F_{\text{cleaning efficiency}}$ (2,22) = 7.301, P = 0.004 < 0.05, $F_{\text{cleaning satisfaction}}$ (2,22) = 6.049, P = 0.008 < 0.05). Further, the LSD post hoc test results (see Table 5) showed that cleaning and maintain of dishwasher B is more difficult than dishwasher A and C, and dishwasher B causes more unsatisfaction.

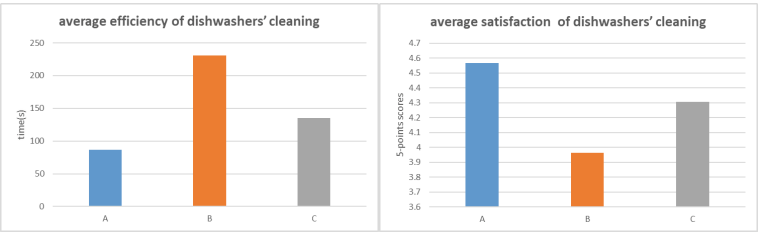

Fig. 5. The average efficiency and satisfaction scores of the three dishwashers cleaning

Table 5. Results of the LSD post hoc test on the average efficiency of dishwashers' cleaning

Dishwasher type	LSD post hoc test result (efficiency)		LSD post hoc test result (satisfaction)	
	Std. error	Sig.	Std. error	Sig.
A vs. B	28.407	.000**	.201	.012*
C vs. B	44.342	.054*	.183	.088
A vs. C	40.721	.257	.128	.067

In the post interview, participants pointed out that the spray arm in dishwasher B is installed in a special way, which requires the user to use the force disassembly cause all users' complaint.

4 Discussion and Conclusion

The present study was concerned with user's objective response and subjective satisfaction on dishwashers through a sequential of the task scenarios. The results of this evaluation shows that, as a kind of exotic, the dishwasher products on the Chinese market have some typical problems more or less. The dishwashers of foreign brand appear more understanding problems and mismatching of Chinese tableware but better structure to clean and maintain than domestic dishwashers.

We can sum up the following contents from this evaluation. Firstly, the structure and component design of the current dishwashers on China markets doesn't match with the Chinese family tableware. Secondly, operation mode design is not consistent with users' using habits. Thirdly, the mode of interface operation is not consistent with the user's cognition. Fourthly, the identification and description is not consistent with the user's cognition. Slightly change on appearance or literal translation into Chinese, cannot really touch the Chinese user pain points.

In future, the development of dishwasher products should concentrate more energies on the contents mentioned above. Dishwasher enterprises should do more research on Chinese consumers' physiology characteristic and cognitive and habits, and strive to meet the consumers' true demands.

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