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Interface Design of Children's Education APP Home Page Based on Emotion Measurement

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Abstract.Take the home page of children's education APP as the research object,the experimental samples were morphologically deconstructed by the method of human-computer interface component deconstruction, and the interactive interface feature space was constructed.In addition, PrEmo experiment was conducted on children users to obtain the emotional image index of users and construct the emotional cognitive space.By using the method of multiple linear regression, the relationship model between the characteristic elements of interactive interface design and the index of user perceptual image is constructed, so as to guide the design of the home page of educational interactive products in line with children's emotional image.This method can obtain the deeper emotional image of children users, guide the design of products more in line with children's emotional needs, so as to improve children's user experience.

1. Introduction

With the in-depth contact of mobile Internet to all walks of life, APP also gradually enters the field of education. According to the 2016 survey data released by ASO big data research center, educational APP ranks the 9th in user demand ^[1]. Children's education market has always been a rigid demand, now the young parents are open-minded, they are in the era of Internet influence, network education has a high degree of recognition.

At present, most of the domestic and foreign children's APP design focuses on product functionality ^[2]. However, few people pay attention to the emotional experience of children users, and the implicit emotional appeals of children users are not included in the process of product development and design ^[3]. In addition, the homogenization of children's APP in function is serious, and it is difficult to highlight the feature points compared with similar products. Therefore, it will become a new trend to improve the competitiveness of products by improving the emotional experience of children users ^[4]. In recent years, many researchers at home and abroad have taken users' emotional appeals as the research focus. Lin li ^[5] et al. proposed to take human-machine interface components as the starting point of product morphological deconstruction method to construct KE model based on multi-dimensional modeling features. Liu zhenghong et al. ^[6] proposed a KE model for constructing multidimensional variables by constructing MMFs space and emotional cognitive space. Xu qiaoqiao ^[7] et al. analyzed children's emotional needs based on Norman's three-level theory of emotion, and guided children's icon design with the semantic difference method in kansei engineering.



2. Analysis of Children's Emotional Characteristics

Debra Levin Gelman^[8], a famous American designer of children's products, divided children into different age groups in his book children's product design in the digital age. Children aged 6-8 years are called "big children". Children at this stage begin to learn to reflect, their thinking starts to spread, but they are still curious about new things. They begin to have their own thoughts and emotional images, and are no longer influenced by others. Young children like exploratory learning, but children aged 6-8 prefer intuitive information to help them complete the task.

Therefore, the research object of this paper is "big children" aged 6-8 years old. Children in this period have the most vigorous emotional brain development and are willing to express their real thoughts. However, the acceptability of emotional expression is also low. In view of this, in order to explore methods for measuring children's emotions, the research framework process of this paper is summarized as shown in figure 1.

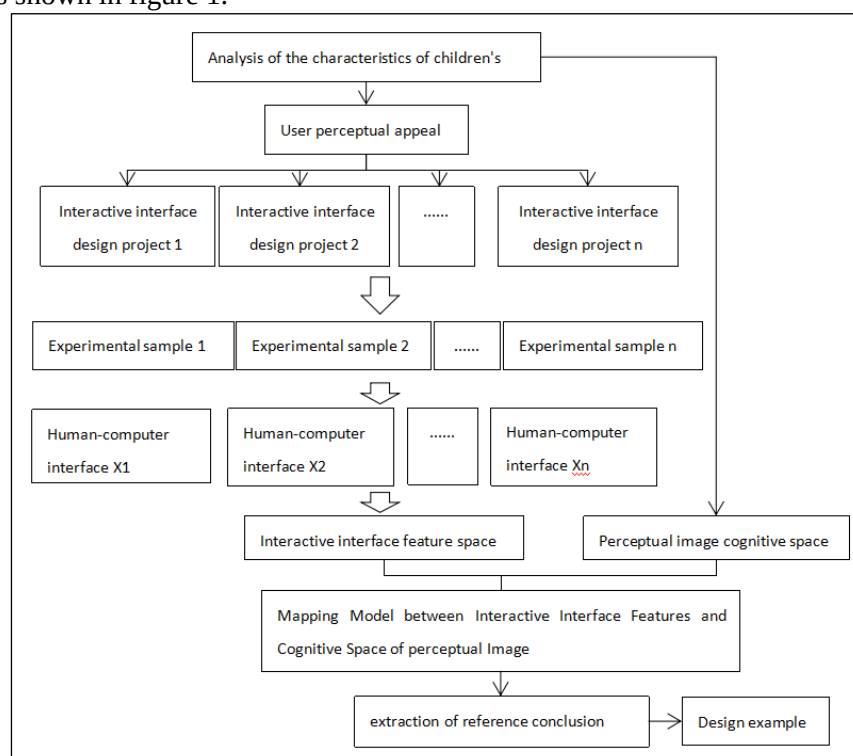


Figure 1. Research flow chart

3. Construction of Children's Emotional Cognitive Space

3.1 Select representative samples

First of all, 20 children's apps were collected in the APP Store as samples. The sample images were of high resolution and covered the main themes of children's education apps. In order to elaborate the research process of this topic, the homepage of children's education APP was selected as the research example, and representative samples were selected. Choice of 21 (4 children product designers with more than 3 years working experience, 17 parents aged 26 to 30) as the research object, screen the homepage interfaces of 20 children's apps, Group them into groups that are considered to have the same or similar layout and interface tone, according to their own image to determine the number of groups and within the number of groups. The investigation results were sorted out and analyzed, The Times of any two samples being divided into the same group were counted, the similarity degree matrix of the lower triangle was sorted out, and then it was transformed into the distance matrix in the multi-dimensional scale. After the multi-dimensional scale analysis with SPSS software, the

six-dimensional spatial coordinates of 20 samples were obtained. After the coordinate was analyzed by clustering analysis method, 4 representative samples were finally determined, as shown in figure 2.



Figure 2. Representative samples

3.2 Build an interactive interface feature space

The nature of products on the home page of children's educational apps is deconstructed by using the method of man-machine interface element (partially) deconstruction proposed by Lin li ^[5] et al., and the interface flow is not included in this study because the research objective of this paper is the interface layout design of the home page. The man-machine interface component is an important carrier to convey perceptual information between users and products. Based on the human-machine interface components, the objective is to deconstruct the smallest perceptual information unit. The nature is the design feature points that users can see and feel, and it is the smallest unit where the emotional interaction between users and the product can occur ^[5]. The global nature (human-machine interface elements) method is used to deconstruct the five dimensions of the subject, background, icon and text of the children's APP home page in terms of form, color, quality, texture and style. First, the main body and background of the interface are non-functional parts, while icons and text are functional parts. Then list the input features (such as number of icons, icon size) and output type features (such as background color), the second one by one, the non-functional and functional components from the Angle of the senses and rational Angle HIEs segmentation, deconstructed 7 non-functional HIEs, as shown in table 1, deconstructed 10 functional HIEs, as shown in table 2.

Table.1 Non-functional

Category	Number	HIEs
Subject	X1	Number of subjects
	X2	The scale of the subject
	X3	The number of main colors
	X4	The hue of the main color
	X5	The material gloss of subjects
Background	X6	The light and shade of the background color
	X7	Background style texture

Table.2 Functional HIEs

Category	Number	HIEs
Icon	X8	Number of ICONS
	X9	Icon style
	X10	Size of the icon
	X11	Icon color tone

Characters	X12	Number of icon colors
	X13	Background texture of icon
	X14	Writing style
	X15	Number of words
	X16	Text size
	X17	Text color

3.3 Construct Emotional Cognitive Space

Based on the above analysis of children's emotional cognitive characteristics, children's cognitive ability to things is still in the development stage, they cannot accurately understand and distinguish the meaning of words, and their verbal expression ability is relatively weak. Therefore, in order to obtain more accurate emotional imagery of children, the PrEmo measurement method proposed by foreign scholar Desmet PMA et al. ^[9] was used to extract emotional imagery indicators of children users.

PrEmo measurement method is a measurement tool for measuring users' emotional imagery proposed by Desmet PMA and other scholars from delft university in the Netherlands. It is a psychological reaction testing technology based on psychology. PrEmo is a non-verbal self-reporting tool that measures 14 emotions often triggered by a product. This instrument has been developed because existing (verbal and non-verbal) tools cannot measure the subtle emotions usually triggered by product design ^[10]. Seven of the 14 emotions represented pleasure (Desired, satisfied, interesting, fascinated, inspired, appreciative and surprised) and seven represented unhappiness (Disgust, dissatisfied, unpleasant, scared, disappointed, bored and contemptuous). Instead of relying on words, interviewees can use animated expressions and sounds to express their emotions. Each of the 14 emotions measured was represented by an animated mannequin, as shown in figure 3. Each animation was rated according to 5 rating scales. The rating criteria were as follows: 1 represents that I did not feel the emotion expressed in the animation at all; 5 represents that I did feel this emotion. The emotional imagery of the subjects can be measured by the scale method.

PrEmo is a cross-cultural and cross-age emotional measurement method. In terms of application, Desmet et al. also applied PrEmo emotional measurement method to the front face design of cars and the design of child seats ^[10-11]. Therefore, PrEmo has been widely used abroad, but has not been popularized and studied in China.



Figure 3. PrEmo emotional sketchpad

Using PrEmo tool to construct the cognitive space of emotional image is based on the investigation of the target user experiment. First, according to the 4 selected experimental samples, and the 17 interactive interface design characteristics (characteristics) obtained by the deconstruction of the experimental samples through the method of global nature (elements of the man-machine interface), are shown in table 1 and table 2. Purposefully, each design feature corresponds to the 5-level emotional animation scale in the PrEmo tool. The diagram of the scale is shown in figure 3 to form the image cognition experiment questionnaire. Three senior children's product designers, three children's educators and 24 children aged 6-8 years were then invited to participate in the experiment. According to the experimental principles of PrEmo, participants were allowed to evaluate one by one on the 5 subscales of each nature of each sample, in which 24 child subjects were guided by 3 child educators.

Through the partially cognitive experiments of the nature's emotional imagery, the evaluation value of the nature of each sample can be obtained, thus constructing a multi-dimensional cognitive space of emotional imagery.

3.4 Parametric treatment of children's emotional needs

The importance coefficients of adjacent components are compared sequentially by using sequential scoring method, so as to judge the main features. Taking no. 3 emotion ("interesting") as an example, in sample 1, it is concluded through DARE method that components 1, 2, 5, 7, 8, 9, 12, 15 have the largest influence coefficient on no. 3 emotion.

The above eight main influence elements were parameterized. In sample 1, the main influence elements obtained by the sequential method included the elements 1, 2, 5, 7 of the non-functional elements and the elements 8, 9, 12, 15 of the functional elements. Of the nature data, 7 are "interesting", =1; If the stereotype data with only the 12th main feature is not "interesting", then =0; Therefore, the main characteristic parameterized array of "interesting" is:

$$([Main(8)])_{1,1} = \{1,1,1,1,1,0,1\}$$

The mean value of the user's emotional evaluation of the no.3 emotional animation ("interesting")

$$\frac{\sum_{m=1}^{30} \sum_{j=1}^{17} A_{i,j}^{m,1}}{30 \times 17}$$

in sample 1 obtained by PrEmo measurement is:

3.5 Build a mapping model from multi-dimensional interactive design features to design perceptual space

Using multiple linear regression technique, the correlation model between user emotion image and interaction design elements is constructed. According to this calculation method and the analogy, in the process of data processing, in order to avoid the occurrence of multicollinearity, the multicollinearity was tested by the variable inflation factor, and it was stipulated that the item variable inflation factor included in the linear regression model should not exceed 10. The values of the main characteristic parameters under each emotion animation are calculated: $([Main(L)])_{i,n}$ and the emotional

$$\frac{\sum_{m=1}^q \sum_{j=1}^r A_{i,j}^{m,n}}{qr}$$

image evaluation mean of each sample under each emotional animation: qr By inputting SPSS software for data processing, the mapping relationship model from the main features of the interactive interface to the perceptual design space can be completed, thus building a multi-dimensional emotional engineering model. Among them, this formula: $([Main(L)])_{i,n}$ represents the parameterized array corresponding to all the main influence characteristics of the i-th evaluation sample of the emotional animation in the NTH PrEmo experiment. Q is the total number of subjects. R is the total number of nature (nature of human-machine interface elements). $A_{i,j}^{m,n}$ is the emotional evaluation value of the MTH interviewee on the JTH nature of the ith sample under the NTH emotional animation.

According to the correlation theory of linear regression analysis, the linear relationship between emotional animation and interactive interface design elements is established, and then the quantitative analysis is carried out. It is assumed that the dependent variable Y1 is linearly related to the independent variable Xi, the dependent variable is the perceptual evaluation value of the sample, and the independent variable is the main characteristic design element, and the functional relationship is established. Taking no.3 emotional animation ("fun") as an example, the multi-dimensional kansei engineering model is established by calculation as follows:

$$Y_1 = -0.891x_2 + 0.691x_5 + 0.493x_7 - 0.970x_8 + 0.327x_9 - 0.751x_{12} - 0.900x_{15} + 4.351$$

Y_1 in the above formula is the kansei engineering model of no.3 emotional animation ("interesting"). X_i is the ith nature; The coefficient of X_i represents the contribution of the human-machine interface element to the influence of no.3 emotional animation ("interesting"), where positive value

represents positive influence and negative value represents negative influence. Positive impact components play a promoting role in guiding the design process to the corresponding emotions, and negative impact components play a hindering role in the design process. Therefore, the design should be based on the emotional needs of the positioning to avoid or reduce such components can also play a promoting role in the corresponding emotions. On the type, element 5, 7, 9 to 3 sentiment animation ("interesting ") have a positive impact, element 2, 8, 12, 15 to 3 sentiment animation ("interesting ") have a negative impact, reduce or reduce these elements can make children education class interactive product page design more "interesting", can effectively improve the user experience of children.

3.6 Interface home page design

According to the experiment, the user's emotional image was obtained and a multi-dimensional kansei engineering model was constructed. The key interactive interface design elements were summarized and analyzed to find the interactive interface design elements and their main features suitable for the homepage of children's education APP. The reference conclusions for the interface design of the homepage of children's education APP were obtained as shown in table 3:

Table3 Reference conclusions of interactive interface design

Category	Number	Main feature element	Reference conclusion
Subject	X1	The number of subjects	The number of subjects is kept at the best of two, and excessive number of subjects will cause visual error.
	X2		The proportion of the main picture is 1:18 is the most suitable
	X3	The number of subject's colors	The number of main colors is three best
	X5	The material gloss of subjects	The subject should have a certain sense of material quality
Background	X6	The light and dark of the background color	Background color selection warm tone
	X7	Background style texture	Interface background suitable for texture filling
Icon	X8	Numbers of icons	The number of icons is 2-3 best
	X9	Styles of icon	Icon style selection line icon
	X10	Size of icon	Icon size is moderate
	X12	Number of icon colors	The number of icon colors is the best in the same color
Characters	X15	Number of words	Control the number of words at the best of six
	X16	Text size	The best text size is 13

The interactive interface design reference conclusion in table 3 as important theoretical basis for children's education class APP homepage design, combining with the building of various samples of multi-dimensional correlation coefficient in perceptual engineering model of comprehensive consideration, determine the children's education class reference design for the homepage of interactive products: the body of the interface color warm color number and not too much; The number of subjects in the interface is moderate, not too much; The proportion of the main page should not be too large; The main material should have a certain luster; Interface background should have texture sense; ICONS should not be too many, easy to cause visual interference; Icon style is linear icon; Too many and miscellaneous icon colors are likely to cause negative emotions of children users. Therefore, the number of ICONS should be uniform and consistent. Text size moderate;

According to the above reference content, the theme function of the APP is defined as an insect knowledge popular science education APP, which is designed in combination with the development size of the Android system and the corresponding design specifications of the interactive interface

design. The final design scheme of the APP homepage for popular science education of children's insect knowledge was obtained, as shown in figure 4.



Fig.4 Children insect knowledge education APP home page

4. Conclusion

This paper takes the home page of children's education APP as an example to deconstruct the interface elements of the home page through the method of human-machine interface component deconstruction. Secondly, emotional image indicators of children users are collected by using PrEmo emotion measurement experiment. The mapping relationship model between emotional image and interactive interface design elements is constructed by using multiple linear regression analysis. Finally, based on the relationship model, the reference conclusions for the interface design of the home page of children's education apps that conform to users' emotional images are derived, and innovative design is carried out. Research shows that the design of children's education APP in the digital age should pay attention to children's emotional appeal while considering product content. Through PrEmo experiment, emotion animation was used to measure the emotion of children users instead of semantic difference method. In this experiment, the emotional needs of children users and the design elements of the interface are considered comprehensively, and the semantic difference method has more reliable emotional prediction ability. Therefore, it can play an effective guiding role in the perceptual design stage of children's products, improve the emotional experience of children users, and provide reference value for the interactive interface design of other children's digital products.

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