

Design and Research of Household Small Electric Drill Based on Users' Perceptual Needs

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ABSTRACT

Objective: to optimize the existing electric drill, improve the visual presentation effect of the electric drill, and bring better experience to users by starting from the perceptual needs of users.

Methods: the semantic difference method in perceptual engineering was used to screen out the relevant perceptual words, make a questionnaire, and analyze the data and the correlation between the data by entropy weight method.

Results: through the analysis of entropy weight method, the importance ranking of perceptual words was obtained, and an electric drill more in line with the needs of users was designed.

Conclusion: under the guidance of perceptual engineering and entropy weight method, users' perceptual needs are rationalized, so as to design a household electric drill more in line with users' needs.

Keywords: Perceptual engineering, Household electric drill, Entropy weight method

INTRODUCTION

Household electric tools are essential tools in daily life. In all kinds of manual labor in life, household electric tools have become a more and more important role in life, and the development of modern technology also provides a guarantee for the safety and convenience of household electric tools. In modern social life, people's demand for daily necessities has gradually changed from need to want, and new requirements have been put forward for product design. When young users buy electric drills, in addition to the functions and operability of electric drills, they will also pay attention to the modeling, experience and their own emotions of electric drills.

Wang Xinyan put forward from the perspective of ergonomics: "through the application of new materials and intelligent technology, the handle can be adjusted through the intelligent screen" in this study, only one part of the electric drill was designed, and the user's favorite products could not be accurately designed without considering the user's feelings. Liu Chuanlong also put forward from the perspective of ergonomics: "improve and innovate the design from the ergonomics, safety, modeling, dust prevention and

other aspects of electric percussion drill.” the electric drill handle is redesigned, and the design thinking of dust cover is added. However, this article also does not start from the user’s point of view, but focuses on the electric drill itself. Jia Shuyuan and others put forward: “analyze and optimize the safety, comfort and drilling accuracy of traditional electric drill” it is mainly through the design of dust cover and positioning scale to achieve improvement and optimization. It also focuses on the product itself rather than the user. At the same time, it also lacks a certain rational analysis method. Wei Yongxia put forward: “the shape design of electric hand drill is realized through perceptual analysis, the realization of perceptual engineering and perceptual evaluation” the design is mainly based on the correlation between word pairs and design elements, and the user’s perceptual needs are transformed into data. However, there is a lack of importance analysis of design elements, and the main design points considered in the design are not obvious.

Through the research on the design of electric drill products, it is found that when designing electric drill products, designers focus more on the product itself and ignore the emotional and experience needs of users themselves, resulting in the lack of certain emotional communication and connection between users and products. Therefore, it is necessary to study and design a household electric drill to meet the emotional and experience needs of users. That is, designers should pay attention to the research of product perceptual image in product design, and reflect users’ emotional tendency in product modeling, material, color and operation mode, so as to enhance the added value of products. At the level of studying the perceptual needs of target users for product appearance, texture, touch and experience, perceptual engineering, as a mature theory, has been widely used in product research and development in various fields in China. Therefore, the research method used in this paper is to mine the emotional needs of users with perceptual engineering, study how to make users get a better emotional experience when using products, and get the design scheme of household small electric drill products.

PERCEPTUAL ENGINEERING AND USER PERCEPTUAL DEMAND THEORY

Perceptual Engineering

Perceptual engineering, first known as “emotional Engineering”, is a new discipline that combines ergonomics, humanized design concept and emotional design concept. Perceptual engineering mainly refers to quantifying people’s perceptual needs with relevant means of engineering, visualizing the quantitative results, and obtaining relevant design directions to guide product design. In short, it is through the study of people’s emotional needs (sensitivity), and then carry out product design according to people’s subjective feelings or preferences. The way that users’ perceptual needs are processed by data helps designers intuitively study users’ emotional trend, guide product design, and enable users to produce positive emotions when using products.

User Perceptual Demand Theory

Users' perceptual needs mainly refer to users' emotional demands for products. Users hope to obtain positive emotional experience when using products. According to Donald Norman's emotional design theory, based on three different design dimensions: instinct, behavior and reflection, user needs can be divided into perceptual needs, cognitive needs and emotional needs. In terms of products, users' perceptual needs mainly refer to that the shape, material, function, operability and color of products will bring users different psychological experiences. Through the research on users' perceptual needs, users can get a better emotional experience when using products.

INVESTIGATION AND RESEARCH ON HOUSEHOLD ELECTRIC DRILL

Investigation on Household Electric Drill

Through the investigation of the existing household electric drill, it is found that the main functions of household electric drill in the market are not very different. The existing household electric drill mainly has the following problems: 1 In terms of the shape and function of electric drills, most of them are of the same shape and are stereotyped. They feel heavy industrialization and are not suitable for home use scenes. In addition, the existing electric drills are overweight and large. For some non-professional youth groups and older people, they are inconvenient to use and difficult to master, so they are prone to deviation and mistakes, resulting in hole deviation Crooked, etc. 2. In terms of safety, the drill bit of the existing electric drill directly leaks out, which will cause damage to the drill bit on the one hand, and lack of certain safety on the other hand. For example, after work, the drill bit is in a hot state, the naked leakage is outside, without any protective measures, and it is very easy to burn the user. In addition, the electric drill will produce huge dust during use, which will not only affect the environment, but also harm the user's health. 3. In terms of color, the color of electric drill products is mainly divided into red, orange, green, blue, yellow and gray.

Product Sample Library

The product drawings of household electric drill are collected in the network and physical stores. Through the collected electric drill pictures, the modeling characteristics, color and material of electric drill in the market, as well as the volume and operability of electric drill are analyzed. Classify and summarize the pictures, such as whether there is a base, whether the angle between the electric drill body and the handle is a right angle or an obvious obtuse angle, and whether the surface design is complex or simple. Then remove the electric drills that are similar in the same category, and finally select eight sample drawings, as shown in Figure 1.

Perceptual Vocabulary Collection and Determination

In order to ensure the rationality and accuracy of words, it is necessary to screen 30 pairs of perceptual words, delete words that are of little significance to the design of household electric drill products, and screen out 6 pairs of effective perceptual words, as shown in Table 1.



Figure 1: sample screening diagram (Source network).

Table 1. Vocabulary screening result table (drawn by the author).

Serial number	Perceptual vocabulary
1	Simple - complex
2	Simple and elegant -Gorgeous
3	Environmentally friendly -polluting
4	Light - heavy
5	Textured - rough
6	Labor saving -laborious

Table 2. Questionnaire (self - drawn by the author).

Simple	-3	-2	-1	0	1	2	3	complex
Light	-3	-2	-1	0	1	2	3	heavy
Simple and elegant	-3	-2	-1	0	1	2	3	Gorgeous
Textured	-3	-2	-1	0	1	2	3	rough
Environmentally friendly	-3	-2	-1	0	1	2	3	polluting
Labor saving	-3	-2	-1	0	1	2	3	laborious

Use Semantic Difference Method to Conduct Questionnaire Survey

According to the eight samples of relevant words selected from Figure 1, and then use the perceptual words selected from table 1 to make a seven level test scale. Let the user evaluate the subjective feeling of each sample separately. The perceptual evaluation vocabulary is the perceptual vocabulary in Table 1. There are seven options in each pair of perceptual vocabulary, and the seven options correspond to seven scores. For example, in sample 1, in the word pair “simple - complex”, the user selects the score according to his subjective feeling of sample 1, The closer the score to the left, the more complex it is. Similarly, the closer the score to the right, the simpler it is. Thus, a questionnaire is made, as shown in Table 2.

Data Quantification Results and Design Direction

Data Collection and Reliability

According to 43 questionnaires, the data were analyzed. table 3 is the average value of the corresponding word pairs of each sample, and the bottom data is the sum of the average values of each word pair in eight samples.

Table 3. questionnaire data sheet (self - drawn by the author).

Sample	Simple - complex	Simple and elegant – gorgeous	Environmentally friendly -polluting	Light - heavy	Textured - rough	Complex Labor saving -laborious
1	-1.4	0.48	-0.68	-1.545	0.185	-1.23
2	1.18	1.75	-0.11	1.545	0.635	0.915
3	-0.12	-1.415	0.67	0.285	0.17	0.105
4	-0.265	0.38	-0.355	-0.225	0.86	0.005
5	1.19	1.56	-0.975	0.82	-0.69	-0.06
6	-1.87	-0.255	-1.29	-1.745	-0.87	-1.205
7	-1.1	-1.755	-1.32	-0.705	-0.455	-0.23
8	-0.54	0.375	-0.195	-0.065	0.64	0.065
SUM	-2.925	1.12	-4.255	-1.635	0.475	-1.635

Table 4. vocabulary data weight table (self - drawn by the author).

Word pair	Simple - complex	Simple and elegant – gorgeous	Environmentally friendly -polluting	Light - heavy	Textured - rough	Complex Labor saving -laborious
Entropy weight	0.157711	0.142389	0.211769	0.162923	0.15844	0.166767

Analysis of Perceptual Vocabulary by Entropy Weight Method

Calculate the weight of each word pair, as shown in Table 4.

According to the weight analysis, it is found that the weight of environmental protection is the highest, followed by labor-saving and lightweight. Combined with the analysis of the average value in Table 3, it is found that among the six pairs of words, what the existing electric drill lacks most is environmental protection and labor saving.

SMALL HOUSEHOLD ELECTRIC DRILL DESIGN INNOVATION SCHEME

According to the above data processing results, it is found that the most important thing of household electric drill is environmental protection, which means that during the use of electric drill, it will not produce a large amount of debris to pollute the surrounding environment and human health; Labor saving and light means that the overall volume of the electric drill should be light and easy to master, so as not to make the hole deviate; Simplicity is the product modeling design to minimize complex design. The above perceptual words correspond to the design elements of household electric drill respectively, as shown in Figure 2. Then brainstorm according to the sample diagram corresponding to the weight results to obtain the design scheme.

Since the electric drill is required to be environmentally friendly and labor-saving, a protective cover is added at the front end of the electric drill. When the switch is turned on, the drill bit of the electric drill rotates out, and the protective cover will collect dust and debris. The overall volume of the electric drill is small, which can achieve the effect of labor-saving.



Figure 2: Rendering (self - drawn by the author).

CONCLUSION

Because the number of samples and the number of questionnaires is limited, there may be some deficiencies. Besides, in the questionnaire stage, we did not take into account the specific use scenarios of electric drills, such as wood drilling, wall drilling, drilling depth and so on..

ACKNOWLEDGMENT

Thank my teachers for their help and team members for their efforts. Thank you.

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