Research on the theory of Fault Tolerance in Chinese Character Design Based on Eye Movement Test

Huang Zhixiong   Zhang Yamin

Xiamen Academy of Arts and Design, Fuzhou University

Xiamen, Fujian, China

13950158200, 38501093@qq.com;15960377950, 544973244@qq.com

Abstract

The goal of this essay is to explore the specific methods and principles of fault tolerance in the design of Chinese character and to enrich the visual representation of Chinese characters. In order to analyze the rational expression of the perceptual expression and demonstrate the forms and advantages of the fault-tolerant design techniques in the design of Chinese characters, the main methods used in this essay are summarizing the status quo of Chinese characters design and practical dilemmas，using the eye tracker as well as the qualitative and quantitative analysis methods by combining with practical examples. The conclusion is that while assuring the identification of Chinese characters, incorporating fault-tolerant thinking and design techniques into Chinese character design, the charm and cultural connotation of Chinese characters and at the same time the meaning of Chinese character design would be enhanced.

Key words: Chinese character design, fault tolerance, eye movement test

Chinese characters are the main carriers and communication tools that can represent Chinese culture and play a vital role in Chinese culture. The development of Chinese characters has gone through a long history and the Chinese character is the only text system which is used up to now in the four major ancient civilizations, and this is worth to be studied. It belongs to two completely different writing systems and cultural thoughts. The differences between Chinese and western languages as well as their cultural development make their typological designs show their own characteristics，and many design concepts and design techniques are not universal. In the era of the contemporary graphic language which is widespread, the design of Chinese characters puts more emphasis on using visual symbols to accurately and quickly express information. In recent years, there have been many designers who have used the essence of Chinese character art in large quantities to closely combine the form of Chinese characters with the form of design and they have set an example for the exploration of Chinese characters and provided a large number of images. The design method of fault tolerance for Chinese characters exploits the stylistic interest and cultural heritage of Chinese characters while satisfying the basic precepts of readable text and recognizable characters. By applying modern graphic design concepts and methods, innovative thinking and methods are provided for Chinese font design.

1. Thinking of Fault Tolerance and Chinese Design

In a preface to the book published in 1962 which name is Conjecture and Refutation, the famous contemporary Western philosopher of science, K.R. Popper, claimed that We can learn from our mistakes, and he had proposed the growth of scientific knowledge (problem-tentative solution - exclusion error - new problem) and trial-and-error method based on achievement (the method of trial and error is the fundamental scientific method that tries to clear the error) [1].

The essence of fault tolerance is to redefine the value and meaning of "wrong", and to discover new possibilities from mistakes. Under the guidance of this function, we could apply the fault-tolerant thinking to the Chinese character design, which would allow the Chinese character design to have more possibilities. In order to convey the message, Chinese characters should be "accurate" and "clear" in writing. However, the design of Chinese characters can pursue visual differentiation in the field of design. This kind of thinking is exactly what contemporary design needs. A large number of visual phenomena can prove that the features of Chinese characters are fault-tolerant, which means that under the condition of moderately destroying the glyphs, the identification of

Chinese characters still exists. Therefore, through the enlightenment of trial and error, the application of Chinese character tolerance in character design could be researched, and the method of writing design could be further explored [2].

2. Fault-tolerant thinking of Chinese Design Applications

2.1 Expressing emotion by the shape

The structure of strokes of Chinese characters is complicated and changeable and the improvement can be made to a certain extent in the design of Chinese characters, which would make it easier for the audience to understand and accept.

The imperceptible features of fault tolerance of the Chinese characters make it possible for the viewer to determine the original words based on the recognition habit without partial or total changes of the fonts, and there would be less misinterpretation. For example, in the poster named "North Korea and South Korea" which is designed by Kan Tai-Keung, the same strokes of "Han" and "Chao" are craftily shared and the words "Moon" and "Wei" are inverted, which makes users think of the status quo of the DPRK and South Korea's separation, but in fact, they are all from the same roots, implying the wishes of reunification and inspiring consideration.

2.2 Simplification due to speediness

Cursive is a typeface of Chinese characters, characterized by a simple structure, strokes, formed in the Han Dynasty, and derived from the official script and aiming to simplify writing. Cursive script is the representative of "erroneous character" typeface, the character of fault tolerance is used to cleverly convey ideas, and the word processing is more individualized. Although the local stroke is omitted, the Chinese characters are still clear, and there is a sense of formalism.

2.3 Varies due to beauty

In the design of Chinese characters, the design operation on the fonts does not simply shape the fonts, but uses the most suitable glyphs to reveal the complex process of meaning, figurative meaning and rich semantics[3]. For example, the work of Zhang Qiang which is the award in the Eighth Founder Typography Competition creative font design has broken through those boundaries of vertical and horizontal structure of Chinese characters, skillfully incorporating fault-tolerant thinking into the font design, but

the fonts from the patchwork of lines are built by the relationship of the fonts to break the past font shape，rather than simply copying the "cross "Pattern style. The combination of changes in the line after the formation of a breathable mesh fonts gives people a new sense.

3. Design and analysis of Chinese character fault tolerance based on eye movement test

Difference is value. In recent years, more logo designs and poster designs tend to use simple Chinese characters as the main visual symbols, which undoubtedly sets higher design requirements for the representation of Chinese characters. Eye movement test is a relatively direct way to get effective data in evaluating people's preferences for a work. By using eye tracking technology to measure the visual attention distribution of the human eye on the piece of design work, the design work can be quickly judged and the reference for subsequent improvement design would also be provided.

3.1 Eye movement test

Generally speaking, the audience's evaluation of the emotion experience of a design work is somewhat subjective because they usually use some theoretical experience. For this reason, in this essay, I use qualitative research supplemented by quantitative research methods, with the guidance of correct theory and rigorous data to support the entire experiment. The two are complementary and can not be isolated.

Tobii Studio Eye Tracker is mainly used in this trial, and the presentation of the stimulus material and the collection of eye movement data are recorded by supporting professional software. The subjects include ten randomly-selected testers, five men and five women, normal color vision, naked eyes or corrected visual acuity, college students aged 22 to 26 years old, and all the testers were told the task before they started the experiment. After being familiar with the whole test process and operation, a formal eye movement test was conducted. Stimulus materials are selected from the more classic font fault tolerance design cases at home and abroad. The pictures are from the Internet.

3.2 Experimental analysis

In this experiment, we selected 15 images from 5 commonly used typographic fault tolerance techniques as stimulating materials (table 1). Among them, 3 were stroke sharing, 3 were locally intensified, 2 were skillfully borrowed strokes, and 4 were contrast between virtuality and

reality, 3 were increase and decrease of strokes.The test data of test quality above 85% were selected from the test results.Row analysis is carried out from four aspects: recognition degree, line of sight motion , fixation time and color contrast.

3.2.1 Recognition

The test process was debugged before the start of the test, each of the stimuli had a 5 second observation time.

two pictures can be identified more accurately after the second viewing , and all of the testers have shown great interest in the design of fault-tolerant fonts.

3.2.2 Line of sight motion

The gaze point distribution map accurately showed the sight momentum of the testers on each stimulus material. The visual design flow of Chinese characters is different according to different fault-tolerant design techniques. In the

TABLE 1

Fault-tolerant practices	Picture of hot spot			Picture of fixation point		
Stroke sharing						
Local strengthening						
Skillfully stroke						
The contrast between the virtuality and the reality						
Increase or decrease stokes						

After the test, the test results and the psychological experience of each picture were written on the spot by the testers. The trail had proved that more than 95% of the testers can accurately read all the stimulus material, and very few

technique of the stroke sharing, the line of sight starts from the upper left corner, and the line of sight is concentrated in the combination of two strokes. In the local strengthening technique, the line of sight is concentrated on the edge of the

outer ring of the font; in the technique of skillfully borrowed strokes, the line of sight is concentrated in the font itself, which is more concerned with the fault-tolerant font with color. In the contrast between the virtuality and reality, tline of sight stays at the combination of fiction and reality, and the overall design can be perceived from the fictional and real sense of the two parts together. In the part of increase and decrease of the stroke, a single enhanced part of the font is more sensitive, and the line of sight is also concentrated in this area.

3.2.3 The fixation time

The fixation time reflects the difficulty of capturing the audience's attention by design elements, and the heat map is the key to the audience's judgment on the degree of preference of a design work. The deeper the color is , the more colors exist in the area,which means that the audience's attention and preferences towards the area are higher. On the contrary, if the fixation point on the hot spot is scattered, it indicates that the audience's eyes jump up and down and the attention is distracted overmuch , and the focus is not prominent. In addition, the Chinese characters based on different fault-tolerant design techniques also have different concerns, but they all attract more attention. According to the data of the hot spot graph, the average stay time of line of sight in deeper color areas is more than 8.6s within the specified 10 seconds, indicating that this area is the audience's interest area, while the average fixation time not in the area of interest is only 1.9s.

3.2.4 Color contrast

The audience's perception and imagination ability of the color itself can communicate the design intention more effectively, and convey the emotional psychological experience with color. As can be seen from table 1, the audience pays more attention to the relatively obvious color contrast in the design of fault-tolerant typefaces, which indicates that it is feasible to use the colors in the design of the fault-tolerant Chinese characters fonts and to increase the contrast, so as to highlight the design communication of one part.

3.3 Test Evaluation Conclusion

The character of fault tolerance of Chinese characters is a powerful advantage of Chinese characters, finite shapes have infinite meanings. In the design of fault-tolerant character fonts, the threshold of fault tolerance is a relatively fuzzy quantitative standard, but recognizability is the primary design premise. On the basis of ensuring the recognition of Chinese characters, using fault-tolerant thinking can better communicate the design intention with the purpose of changing the strokes, parts and structure of Chinese characters. In the application of Chinese character design, eye movement test could be used to help designers make real-time changes to the design work and to enhance the quality of their design work.

4. Conclusion

Through the research on "mistake", it is the main feature of the fault-tolerant thinking of Chinese characters to give full play to the significance of "mistake" [4]. The traditional Chinese font design mainly depends on the designer's own experience and perceptual cognition in order to determine the shape and recognition degree of the font design, but it sometimes lacks scientific basis, and may not reach a consensus with the audience on the image cognition. The use of eye movement test can provide an effective evaluation criterion and auxiliary means for Chinese character font design fault tolerance and recognition, and provide a quantitative research method for the study of Chinese character recognition "fault tolerance". While redefining and thinking about the value of "fault tolerance" in Chinese character design, the attitude of Chinese character designers in scientific research would be reflected from one side and we should do research and try in constant trial and error. This paper has only analyzed the hot-spot map, line-of-sight scanning path and subjective evaluation, and has some limitations. Later, some data such as hot map, line of sight scan and region of interest would be researched and analyzed in a more comprehensive and detailed manner, aiming to make the results of assessment more accurate and effective.

References

[1] Xie Zhenhua: "Pope" four paragraphs on the trial and error method "value" [M], Beijing Education (Higher Education Edition) 2005 edition, pp.15.

[2] Yang Meng, based on the Chinese characters "erroneous" text design practice and research [D], January 2011.

[3] Yun Shuangqing, tolerant thinking and modern Chinese art design [D], May 30, 2009.

[4] Zhang Xian, Chinese character culture and modern graphic design [M], Hunan Normal University Press, pp.187-189.