Experimental Text Design Study on Visual Characteristics of Children with Chinese Dyslexia

Yajie Jiang(✉)

Xiamen Academy of Arts and Design, Fuzhou University, Xiamen 361000, Fujian, China
jiangyajie66@sina.com

Abstract. Chinese dyslexia is a major obstacle to children's learning progress. This study analyzes the visual and internal characteristics of children's dyslexia, summarizes the adverse psychological and physiological effects of the disease on children, and puts forward two kinds of phenotype design and practical design, so as to alleviate the adverse effects of Chinese dyslexia on children, schools, families and society, improve their learning efficiency and further promote the development of social cultural quality.

Keywords: Chinese dyslexia · Children · Character design representation

1 Introduction

Reading is a behavior that will affect a person's life. Being unable to read will become an obstacle to a person, a country and a society. As one of the main groups of reading, children, a vulnerable group, need to be paid attention to. In western countries, the research on the symptoms of dyslexia has a history of more than 100 years, and has formed a relatively perfect eye movement theory and model based on English letters. However, the research on Chinese dyslexia is underdeveloped. Stevenson et al. found that the incidence of dyslexia in Chinese was not lower than that in English letters through ten cognitive tests and standardized reading tests [1]. Only in Taiwan, China, the incidence of Chinese dyslexia reached 7.5%, which was not lower than that of Pinyin [2]. According to the relevant tests of Beijing Academy of Educational Sciences, the incidence of dyslexia in Chinese Mainland was 10%.

2 Overview of Chinese Dyslexia

Dyslexia is a reading-learning disorder caused by a mismatch between processing of visual information and processing of auditory information by the brain, while Chinese dyslexia refers to a condition in which people with the condition lack the ability to process characters and figures in the Chinese language [3]. Chinese dyslexia is a very common learning disability that is closely related to eye movements but not to IQ, mainly

Y. Pogrebnyak and R. Hou (Eds.): ICLCCS 2022, ASSEHR 689, pp. 387–394, 2023.
https://doi.org/10.2991/978-2-494069-27-5_42

in spelling, decoding and vocabulary recognition. Patients cannot spell and read words as easily as normal people, so they are usually less efficient and slower in the learning process, and often spend more time than normal people. This group tends to have an auditory priority, their listening skills tend to be better than their reading and writing skills, and their spatial thinking and expression skills are better than single linear thinking and expression in this group.

2.1 Representational Characteristics of Chinese Dyslexia

The representational characteristics of Chinese dyslexia in patients are usually characterized by externalizing behaviors such as difficulties in word recognition, confusion or reversal of the order of similar characters, and writing mirror characters.

Firstly, difficulties in word recognition are the most significant feature of Chinese dyslexia [4], and manifested as the processing deficits in phonological information. Based on this ability defect, children do not have the ability to understand words, and lack the understanding of the concept of words, which is easy to lead to insufficient psychological level of children (Fig. 1).

Secondly, the confusion or reversed order of characters with similar form belongs to defects in visual processing information, such as regarding "b" as "d", regarding "m" as "w", and so on. They would mess up the left side, right side, upside and down side of the characters (Fig. 1).

Thirdly, written mirror characters belong to the defect in visual processing information. Patients are easy to see mirror characters when they are literate [5]. However, the reading order of the mirrored characters is the same as that of normal people. Mirror characters increase the recognition difficulty of children with dyslexia. For example, the written mirror glyphs of "何时杖尔看春雪, 我与梅花两白头 (walking with walking stick to see the snow, plum and I were in the white snow)" are as shown in Fig. 2.

Fig. 1. Symptom 2 (written by the author).

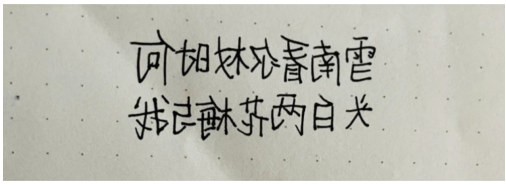

Fig. 2. Symptom 3 (written by the author).

2.2 Intrinsic Characteristics of Chinese Dyslexia

The intrinsic characteristics of Chinese dyslexia mainly include three psychological effects: priming effect, psychological rotation and visual crowding effect. By studying these psychological reactions, it is feasible to provide basis for design practice and achieve the purpose of alleviating children's dyslexia.

2.2.1 Priming Effect

Priming effect is a kind of preference effect of existing stimulus on subsequent stimulus, which is generally divided into two types of perceptual priming and semantic priming. According to Zou Yuliang, it is proposed that the priming effect has little significance for the recognition of graphics, but the character recognition is greatly affected by the lack of character and phonetic representation or processing ability of cognitive processing of Chinese characters, which leads to the dyslexia [6]. For example, when a circle appears among numbers, people tend to regard it as "0", but when it appears among letters, people regard it as "O". Therefore, priming effect can accelerate the reading speed of children with dyslexia and improve their learning efficiency.

2.2.2 Mental Rotation

Mental rotation is the ability to imagine the picture of self or object undergoing a spatially motivated transformation, often manifested in dyslexia. According to the researches, children with dyslexia and normal children both process visual stimuli of text differently in a state of mental rotation. For children with dyslexia, they need to pay more attention to their mental rotation ability to avoid slow reading speed at the mental rotation level [7].

2.2.3 Visual Crowding Effect

Visual crowding effect is a phenomenon that other stimuli near the target stimulus lead to impaired target stimulus recognition [8], that is, different individuals are disturbed by crowding effect to different degrees. Researchers believe that the visual crowding effect can help readers to divide words through inserting spaces, so as to strengthen the representativeness of words and improve reading efficiency.

2.3 Adverse Effects Caused by Imperfection of Children with Dyslexia

2.3.1 Psychological Problems of Children

Some researchers believe that children with dyslexia are more likely to have negative emotions than normal people [9]. Such patients show anxiety, depression and inferiority, and anxiety shows a developmental trend [10]. At the same time, negative emotions will aggravate dyslexia, resulting in the deterioration of psychological emotions and even the emergence of personality development disorders [11].

2.3.2 Increased Family Pressure

For families with children's dyslexia, parents usually need to spend more time and energy than normal families. The negative emotions generated will aggravate the negative emotions of children with dyslexia, thus aggravating the symptoms of dyslexia of children.

2.3.3 Expansion of Cultural Education Stratum of Social Quality

Considering the dyslexia, the educational development of cultural quality is not balanced. According to the data, many adolescents have dyslexia. It is known that patients with dyslexia are in a difficult situation, and it is necessary to make some designs to alleviate their symptoms.

3 Chinese Character Design Requirements Based on the Characteristics of Dyslexia

Ronald D. Davis also summarized eight abilities that dyslexics might have in the "ability of dyslexics": using the brain to change and create perception, being more curious than ordinary people, being highly aware of the environment, thinking through images, being highly insightful and intuitive, being good at visualizing thinking experience, having vivid imagination, multi-dimensional thinking and multi perception. Through the analysis of these eight abilities and the psychological reaction of children with dyslexia, the following four design principles are summarized.

3.1 Suitability of Characters for Children with Dyslexia

The age of children with dyslexia is mainly between 6 and 12 years old, so the character should be designed according to the psychological habits of this age group [12]. In terms of sensitivity to graphics, the ability of children at this age to recognize graphics is better than that of normal characters. Therefore, in the design, it is suggested to improve the recognition of characters for children with dyslexia through graphics. In terms of color selection, there should not be too many colors in the design process. For ordinary children, rich colors can improve attention; but for children with dyslexia, too many colors are the resistance in the reading process. As a result, it is suggested to avoid too many color combinations in the design, and mainly use black, white and gray, so as to reduce the obstacles in the learning process of children with dyslexia.

3.2 Requirements for Character Recognition

According to the survey, when using characters, the recognition speed of children with dyslexia to the Mangal and Microsoft Yahei is faster than that of regular script. It can be seen that the recognition ability of children with dyslexia to these three characters from large to small is Microsoft Yahei, Mangal and regular script respectively. Therefore, Microsoft Yahei is the best choice for children with dyslexia in terms of character design.

3.3 Children's Affective Needs in Learning Process

Donald Norman elaborated the role of aesthetics in "design psychology · emotional design": "attractive things can make people feel happy, thus making people more creative." The same is true of character design. Characters need to be creative and age-appropriate to meet the emotional support. In particular, children have a strong demand for emotional design. Designers need to pay attention to and meet the emotional needs of children, a user group, and establish emotional ties with users, so as to achieve resonance with children. In addition, it is suggested to meet their personalized requirements through emotional design. Each child with dyslexia can be given spiritual comfort, and pay attention to emotional and psychological needs, so as to reduce the symptoms of dyslexia.

3.4 Visual Requirements During Reading Process

Different from normal children, children with dyslexia have higher requirements for visual presentation than normal children. Color difference cannot be used in color selection. Children with dyslexia are more sensitive to colors with high contrast. Even, it will lead to dizziness or blurred symptoms during reading and learning process. In the process of design, the color that belongs to the same color or has little color difference can be used. For example, the collocation of white and light gray, black and dark gray, light coffee and light yellow, etc. is the best. However, the collocation of black and white should be avoided. The two extreme directions on the color ring of black and white are the colors with the strongest contrast among all colors. In the use of graphics, it is suggested to use geometric figures such as triangles and rectangles to strengthen the simplification of vision.

4 Application of Dyslexia in Chinese Character Design

Before starting the design, the designers need to deeply understand the characteristics of children's pathological diseases, sort out the physiological and psychological causes of children with dyslexia, and collect the design methods and ideas for in China and foreign countries. Foreign researches on characters related to dyslexia have obtained some achievements. At present, there are two main types of characters related to dyslexia in English, namely, OpenDyslexic and Dyslexie Character. The design method is mainly to change the thickness of the character that is easy to mirror and to bold the initial letter. However, there are differences in the character structure between Chinese and English, so the design method of English letters cannot be copied into Chinese. In the design for Chinese dyslexia, Chinese, as a pictograph, is much more complex than English characters. Chinese characters can learn from English design methods and be designed in combination with the overall style of Chinese characters.

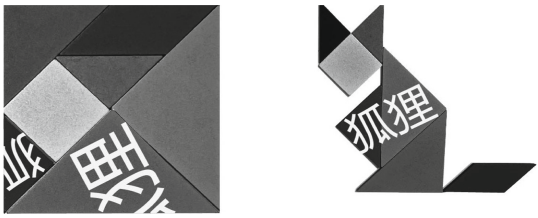

Fig. 3. Designing fonts for dyslexic patients, design 1 (designed by the author).

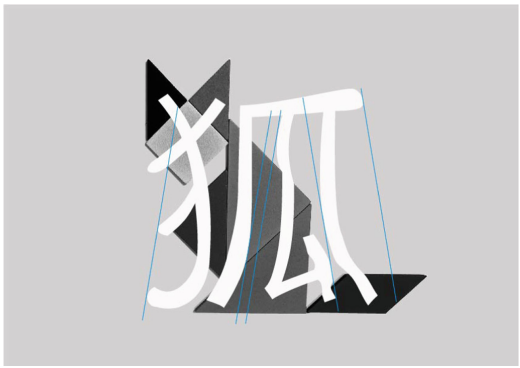

Fig. 4. Designing fonts for dyslexic patients, design 2 (designed by the author).

4.1 Visual Design Method for Children with Chinese Dyslexia

The main purpose of visual expression of children with Chinese dyslexia is to express the world in the eyes of children with dyslexia. By analyzing and studying the psychology and physiology of children with dyslexia, the character design is carried out in combination with the characteristics of human vision with the method of reproducing mirrored, dizzy, blurred, partially missing character forms.

4.2 Solution Design Methods for Children with Chinese Dyslexia

In view of the psychological effects of children with Chinese dyslexia, the following points are summarized (Table 1). First, the character spacing becomes larger to reduce the interference of visual crowding effect. In addition, when the character spacing is larger, children with dyslexia have higher ability of character recognition. Second, in particular, when a single character is used, it pays attention to the use of graphics. For example, it can use the graphic carrier of tangram, which can arouse interest (as shown in Fig. 3). Third, the character design should be interactive and interesting for children. Fourth, while paying attention to the thickness of each stroke, it is necessary to pay attention to the balance and center of a single character to achieve visual effect (Fig. 4). Figure 3 and Fig. 4 are the author's attempt to design "狐狸 (fox)". Figure 3 uses the graphic advantages of the tangram to combine with the text. In Fig. 3, the left picture is the shape of the tangram without disassembly, and the right picture is the shape of "fox"

Table 1. Symptoms and methods of children with Chinese dyslexia

Psychological effects	Corresponding Performance	Solutions
priming effect	Circle refers to "0" among numbers and "o" among letters	With the help of thinking set, it is necessary to use tangram for graphic splicing
Mental rotation	For all children, the angle of 0 degrees is the best for recognition, and that of 180 degrees is the worst	Increase the rotation angle of the character
Visual crowding effect	Low reading speed due to small spacing among characters	Larger spacing among characters (spaces)
Visual habits	Slower reading of characters	Words should not be in the same thickness; it is necessary to focus on balance; and thicker lines should be at the bottom of the character to avoid flip.

after borrowing the tangram, and the Chinese character for "fox" is also displayed, to make them learn fonts through experience, so that children with dyslexia can remember that the splicing method on the right is a fox, and the words are written like this. Even if these children can't fully see what the word is, at least they can remember in their minds that the word is "fox". Figure 4 shows the shape of the tangram after splicing into a fox figure, and the text is deformed, which is more in line with the reading style of children with dyslexia.

5 Conclusion

Through the above design, the purpose of publicizing children's dyslexia symptoms is achieved, so as to better physically treat their symptoms. One of the above two design forms is application-based design (Fig. 3), which is interactive design to help children with dyslexia; the other is performance-based design (Fig. 4), which expresses the need to design for dyslexic children by showing the fonts in the view of a child with dyslexia. Children with dyslexia are a special group in this society. At present, they are in a poor living situation, but their right to read cannot be deprived. Designers should help dyslexics improve their reading efficiency, enhance their self-confidence and improve their happiness within the scope of what they can do. Children's dyslexia is a social problem. By studying the psychology of children with dyslexia, it is suggested to improve the learning efficiency and psychological confidence of the sick children, so that they can get a better reading experience. In the long run, it also contributes a little to the society.

Authors' Contributions. This paper is independently completed by Yajie Jiang.

References

1. Stevenson H W, Stigler J W, Lucker G W, et al. Dyslexia: the cause of Chinese, Japanese and English Child Development, 1982, 53: 1164–1181
2. Guo Zhiying. Research on Visual Crowding Effect of Chinese-speaking Children with Developmental Dyslexia [D]. Tianjin Normal University, 2016. (in Chinese)
3. Liu Tong. The barrier free designing research for dyslexia [J]. Design, 2017(09):138–139. (in Chinese)
4. Zou Yuliang. The priming in Chinese characters and picture recognition for Chinese dyslexic children [D]. Huazhong University of Science and Technology, 2008. (in Chinese)
5. Lin Aiping. Research on Visual Emotional Design for Dyslexia [J]. Industrial Design, 2021(10):69–70. (in Chinese)
6. Han Jing. Syntactic priming in Chinese sentence comprehension [D]. Nanjing Normal University, 2013. (in Chinese)
7. Li Jinya. Characteristics of psychological rotation of different materials for children with Chinese dyslexia [D]. Xinjiang Normal University, 2020. (in Chinese)
8. Wang Jingxin, Li Sha, Hao Lisha, Zhang Xue, Zhang Kuo. Inserting Spaces Benefits Chinese Developmental Dyslexic Children for Reducing their Visual Crowding: Evidence from Eye Movements [J]. Journal of Psychological Science, 2019,42(04):834–840. (in Chinese)
9. Yang Yue, Liu Menglian, Zhao Jing. Developmental Changes of Anxiety and Depression in Chinese Children with Developmental Dyslexia [J]. Advances in Psychology, 8(9), 1388–1395, 2018. (in Chinese)
10. Carroll, J. M., & Iles, J. E. (2006). An Assessment of Anxiety Levels in Dyslexic Students in Higher Education. British Journal of Educational Psychology, 76, 651–662.
11. Davis, K., Margolis, A. E., Thomas, L. et al. (2017). Amygdala Sub-Regional Functional Connectivity Predicts Anxiety in Children with Reading Disorder. Developmental Science, 1326–1336.
12. Wang Xianli. Research on visual design based on visual characteristics of dyslexic children [D]. Central China Normal University, 2019. (in Chinese)