

The Impact of Font Design Based on Cognitive Psychology on Reading Experience

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Abstract: From the perspective of cognitive psychology, this paper examines and analyses how Font design affects the reading experience through four dimensions: visual perception, attention allocation, cognitive load and emotional response. It explores the effects of font attributes such as readability, glyph characteristics and word spacing on reading speed, comprehension and memory retention. It also proposes principles of font design based on cognitive psychology, aiming to provide guidance for designers and content creators to enhance users' reading efficiency and satisfaction.

Keywords: Cognitive Psychology; Font Design; Typography; Reading Experience; Design Principles

1. Introduction

With the rapid development of digital technology, the presentation form of reading materials is becoming more and more diversified, from traditional paper books to electronic screens, the change of reading environment puts forward new challenges and requirements for font design. As a visual carrier of information transmission, Font design not only carries artistic and aesthetic values, but also influences our cognitive process and reading experience in an invisible way. Cognitive psychology, as a discipline that deeply explores human cognitive mechanisms, provides us with a unique perspective to examine the influence of Font design on reading behaviour. Cognitive psychology and Font design interact with each other to shape the richness and depth of the reading experience.

2. The Relationship between Font Design and Cognitive Psychology

As an important carrier of information transmission, text plays an irreplaceable role in communication and recording. Whether in

traditional paper publications or in digitalised screen displays, Font design plays a crucial role, which is not only related to reading comfort, but also affects the efficiency and effectiveness of information dissemination. Effective Font design can enhance the readability and accessibility of information, and at the same time, it can also stimulate the emotional response of readers and enhance the attractiveness and influence of information. Therefore, font design is not only the beautification of text form, but also the optimisation of information transmission and visual communication. Through the theory of cognitive psychology, it can better help designers and meet diverse reading needs.

2.1 Overview of Cognitive Psychology

Cognitive psychology is a discipline that explores the cognitive process of human beings and its psychological mechanism, which refers to the process of converting, processing, storing and extracting the information from external stimuli into the human brain, and the core theory is the information processing theory [1]. Cognitive psychology in the broad sense refers to the cognitive process of human beings, encompassing attention, perception, memory, language and other cognitive processes, emphasising the mobility of consciousness and human subjectivity: cognitive psychology in the narrow sense refers to the psychology of information processing from the perspective of computer information processing [2]. From the reception of external information by the senses to the processing of this information by the brain, cognitive psychology explores every aspect of this continuous process. It uses methods such as experimentation, observation, and advanced neuroimaging techniques to reveal the working mechanisms of cognitive functions such as perception, attention, memory, language, and thought.

2.2 The Cognitive Psychology Foundations of

Font Design

As a relatively independent form in graphic design, Font design is one of the important elements in design. After careful design, fonts present a symbolic representation that integrates cultural communication and emotional expression, using visual effects to express the meaning of the text itself [3]. Cognitive psychology provides a solid theoretical foundation for font design, revealing how font design can be carried out through theoretical knowledge of visual perception, attention allocation, cognitive load and emotional response.

In cognitive psychology, the human perceptual system is the primary aspect of information processing. Through the sensory organs such as eyes, ears and skin, information from the external world is received, and this information is transmitted to the brain for further processing through neural signals. This process is the basis of cognitive psychology research, especially in vision, hearing and touch. The importance of visual perception as one of the main ways for humans to acquire information cannot be overstated. Light stimuli captured by the eye are transmitted via the optic nerve to the brain, which then parses and understands this information. The human visual system is characteristically selective due to the high selectivity of neurons in the optic cortex, which is determined by the physiological properties of the optic nerve [4]. This selectivity allows the visual system to quickly identify and distinguish between different visual features such as shape, colour and motion. The cognitive process of text follows this same principle. As a symbolic system for conveying information, the morphological contours of words are the basis for our recognition and understanding of words. In the cognitive process, the shape of words provides us with the first impression and becomes the main source of information for cognitive behaviour. Text consists of strokes, and the direction, thickness and structure of each stroke have an impact on the cognition of text.

In cognitive processing, faced with a large amount of information and limited cognitive resources, attention is the link that sifts and filters the information [5]. Attention allocation theory states that attention during reading is a limited resource. Effective Font design can optimise the information processing process by directing the reader's attention through visual

hierarchy and layout. Attention selectivity is influenced by a combination of individual subjective and objective factors. Subjective factors relate to an individual's understanding of the information source, needs, interests, experiences, and emotions, while objective factors relate to the physical characteristics of the information itself, such as colour, shape, and quantity, which influence the intensity of stimulation to the individual. Attention has been studied in terms of three dimensions, namely selectivity, persistence and distribution, in order to analyse its impact on information processing. Font design plays a crucial role in cognitive processing. By taking into account visual hierarchy, layout, colour, shape and individual differences, Font design can significantly improve the allocation efficiency of attention, and thus improve the overall reading experience. Cognitive load theory further explains the effect of task complexity on cognitive efficiency. Cognitive load theory was first proposed by Sweller [6], which argues that complex tangible information and intangible information that lacks guidance in learning will lead to an increase in the workload of the learner, creating a higher cognitive load, which in turn reduces the effectiveness of the learning process [7]. When creating fonts, designers need to take into account the visual complexity of fonts, as this is directly related to the cognitive load of the reader during the reading process. Overly complex font designs may cause readers to consume more cognitive resources when decoding text, thus affecting reading speed and comprehension.

Emotional cognition theory plays a regulatory role in the cognitive process, affecting information processing and memory. Emotions not only affect the allocation of an individual's attention to information, but may also alter the depth and manner of information processing. The effect of emotion on memory is reflected in the fact that emotional events tend to be more easily encoded, stored and retrieved, and emotionally coloured information improves memory consolidation, making it easier to retrieve such information in subsequent memories. Emotions and cognition are not independent systems, and emotions often have a significant impact on the decision-making and feedback phases of human cognitive processes [8]. American cognitive psychologist Donald Norman first put forward the concept of

"emotional design" to emphasise the importance of emotional needs and emotional experience in product design [9]. Emotional design theory consists of three interrelated levels: instinctive, behavioural and reflective. These three levels are continuously developed and deepened on the basis of humanised design. In the field of font design, affective design theory has the same important application value. When designing fonts, designers should take dynamic effects, interactivity, sensory stimulation and other factors into consideration. Through this multi-dimensional design approach, designers can build a delicate emotional bond between the viewer and the text, achieve efficient information transfer based on the viewer's cognition, and ultimately achieve the goal of emotional design, creating beautiful and touching font works.

3. Visual Perception and Attention Allocation

3.1 Attraction of Visual Features

The human visual system has an inherent computational limitation in processing visual information, a limitation that causes neurons in the visual cortex to exhibit significant selectivity for static and dynamic features of visual stimuli. This selectivity not only forms the basis of visual perception, but is also a core cognitive theory in the field of design. In the academic field of visual communication, and in particular in the practice of typography, this feature selectivity of visual perception plays a key role. Designers must carefully regulate the size, form, colour and spacing of fonts based on the principles of visual perception. Academic research has shown that font size has a significant impact on visual processing efficiency. Academic studies have shown that font size has a significant impact on visual processing efficiency. Smaller fonts can overwork the visual system, reducing reading speed and depth of understanding. On the other hand, appropriate font size can reduce the consumption of cognitive resources and accelerate the visual decoding process of text content, which is especially effective in fast scanning reading contexts. Therefore, the determination of font size must balance the needs of visual clarity and aesthetic layout to ensure the efficiency of information transmission and reading comfort. The structural characteristics of a typeface are

crucial to improving the recognisability of text. The clarity of the typeface, the contrast of the strokes, and the uniqueness of the letters are key to improving the speed of recognition. For example, sans-serif fonts exhibit better legibility in screen reading due to their clean lines, reducing visual confusion and making them particularly suitable for long-duration readers or readers with limited vision. This is consistent with the law of closure in Gestalt psychology, which states that people tend to complete visual information, and good typography can facilitate this cognitive process.

3.2 Formation of Attention Focus

Font design must carefully consider how to guide the formation of attention focus through visual elements. Designers use visual prominence, such as contrast in weight and color, to quickly attract readers' attention to key information. Reasonable spatial layout, proper alignment, line spacing, and paragraph division not only optimize the visual hierarchy of the text but also facilitate a natural transition of attention during the reading process. In addition, the contrast and visual fluidity of font design are also crucial for maintaining readers' focus and understanding, working together to reduce visual interference and enhance the efficiency of information transmission.

The clarity of the hierarchical structure distinguishes various parts of the text through different levels of font styles, assisting readers in identifying and remembering the text structure. Environmental adaptability requires designers to consider the diversity of reading environments, ensuring that the font remains legible under different lighting and backgrounds. In digital media, moderate dynamic changes can serve as an innovative means of guiding attention, but their application must be cautious to prevent excessive distraction of readers' attention.

4. Readability and Cognitive Load

4.1 Enhancing Readability

From a cognitive psychology perspective, typography is crucial to improving the legibility of text. Professional typography requires careful consideration of the clarity of glyphs to ensure that the outline and shape of each character is quickly recognised by the visual system, thus reducing cognitive load and speeding up decoding. For example, sans-serif fonts often

show better readability on digital screens due to their clean lines. At the same time, the contrast between the thickness of the strokes and the uniqueness of the letter design enhances the recognition of the glyphs and avoids potential confusion, which is crucial for improving reading fluency. In addition, high contrast between colours and background is another key factor in enhancing legibility, which not only enhances the prominence of the text, but also helps to maintain the reader's focus. Appropriate character spacing and line spacing settings help text content to be chunked more efficiently, reducing the number of visual jumps and back-reading, which in turn improves comprehension.

4.2 Reducing Cognitive Load

Cognitive load theory points out that the working memory capacity of the brain is limited when an individual performs a task; too high a cognitive load will take up more working memory resources, thus affecting the efficiency and quality of information processing. Various cognitive processing activities in the problem solving and learning process need to consume cognitive resources, resulting in a certain cognitive load. If the total amount of resources required for all activities exceeds the capacity of working memory, it will cause insufficient allocation of resources, thus affecting the efficiency of individual learning or problem solving, and this situation is known as cognitive overload [2].

The cognitive load theory proposed by J. Sweller is divided into three main categories: intrinsic load, extrinsic load and related load. Intrinsic load is determined by the inherent characteristics of the material such as complexity and sophistication and the learner's original level of knowledge together, and is unchangeable; extrinsic load involves the design of the teaching or learning material, and is a factor that is controllable by the designer; and the relevant load is the result of the interactions between the learner's prior knowledge and the new information, which emphasises the role of individual differences in the processing of information. Projecting this theory onto the field of font design, we can gain insight into the fact that the characteristics of a typeface act directly on the extrinsic cognitive load and indirectly on the intrinsic and relevant load. For example, the size and shape of fonts, as essential elements of design, are critical to the speed and accuracy of

decoding information.

When font design is too complex or irregular, readers need to devote more attentional resources to decode the text, thus increasing the cognitive load. On the contrary, sound typography reduces this load and allows the reader to focus more on the textual content itself rather than the presentation of the text. The size and shape of fonts are key factors that affect cognitive load. Research has shown that appropriate font size not only reduces the burden of focus adjustment on the eyes, but also reduces the difficulty of visual search so that readers can recognise characters more efficiently, thus reducing cognitive load. The shape of the font, including the thickness of the strokes and the clarity of the glyph structure, is equally crucial. Simple, well-balanced font design helps to recognise and process visual information quickly, reducing the brain's decoding time and lowering the complexity of cognitive processing. For example, sans-serif fonts are often considered to provide a lower cognitive load in screen reading due to their straight lines and simplified forms.

5. Emotional Resonance and Cognition

5.1 Stimulation of Emotional Empathy

American psychologist Donald A. Norman, in his emotional design theory, places emotion on an equal footing with cognition, considering that "emotion is an integral and necessary part of cognition" [10]. There is a complex interplay between emotional responses and cognitive processing. Emotion not only affects the speed and depth of an individual's information processing but is also directly related to the persistence and pleasure of reading. Therefore, integrating the theoretical foundation of emotional response into the considerations of font design is crucial for constructing a more comprehensive and in-depth reading experience model.

Emotional resonance is a deep connection established between the perceiver and the creator through the work. In the field of design psychology, emotional design is regarded as an important area of study. It emphasizes that products should not only meet functionality and usability but also touch the emotions of users and reflect their inner world. When an artistic work can evoke a deep resonance in the perceiver, making them feel that the work expresses exactly what they have longed to

express, this design has achieved the state of emotional resonance. Emotional design is a reflection and transcendence of modernist design, which overemphasizes function orientation and neglects personal emotions and feelings. It emphasizes that designers should transform human emotions into tangible design elements to meet people's inner emotional needs and spiritual pursuits, making design principles more "humanized."

Designers need to further explore how to meet users' emotional needs through font design on the basis of satisfying usability, achieving harmonious development of human-computer relationships. Through emotional design, fonts are not only carriers of information but also become a bridge for emotional communication, bringing joy and emotion to people's lives. Designers should consider how to evoke the target emotions through font design, which requires a deep understanding of the target audience's cultural background, aesthetic preferences, and expected emotional responses. For example, for children's books, using lively and cute fonts with bright colors helps to stimulate curiosity and happiness, promoting interest in learning; while for professional reports, simple, clear, and slightly formal fonts may be more appropriate to convey professionalism and trust.

5.2 Enriching Cognitive Experience

As a part of visual communication, typography can enrich readers' cognitive experience. Through the use of different typographic elements and techniques, designers can create diverse visual effects and reading experiences, so that readers can gain visual enjoyment and satisfaction while acquiring information. In different cultural backgrounds, people's preferences and cognitive styles of font design will be different. For example, Chinese culture pays attention to the tradition of calligraphy and has a special concern for the beauty and fluency of character shapes. As a result, brush lines and rounded glyphs can often be seen throughout Chinese designs to appeal to the Chinese people's love and respect for traditional culture. In addition, in Western culture, font design focuses more on simplicity, modernity and a sense of professionalism. The use of serif and non-serif fonts is more widespread, and the adjustment of word spacing and line spacing pays more attention to the beauty and visual

effect of the overall layout. This also reflects the pursuit of simplicity and efficiency, as well as the importance of personal expression and innovation in Western culture.

6. Conclusion

Through an in-depth analysis of the profound impact of typography within the framework of cognitive psychology on the reading experience in the digital age, the intrinsic connection between design principles and reading experience and comfort is revealed. It is found that by precisely adjusting the size, shape, colour and spacing of fonts, not only can the speed of information reception and the depth of comprehension be significantly enhanced, but also visual fatigue can be effectively relieved and the overall reading enjoyment can be enhanced. In summary, this paper demonstrates the effectiveness of font design based on cognitive psychology in enhancing the digital reading experience, further confirming the practicality and necessity of cognitive psychology principles in guiding font design, which not only brings scientific theoretical support to the field of font design, but also opens up new paths for future research. Future research could further explore the association between font design and specific reading, develop more inclusive fonts, and investigate the principles of font design in emerging technologies such as virtual reality and augmented reality to cope with a wider range of reading scenarios and technological changes. In short, continued and deeper integration of cognitive psychology and typography will continue to push digital reading towards being more efficient and user-friendly.

References

- [1] Wang Su, Wang Ansheng. Cognitive Psychology. Beijing: Peking University Press, 2003: 2-6.
- [2] Geng Junyi. Research on the Interactive Training Design for Mild Cognitive Impairment in the Elderly Based on Cognitive Psychology. East China University of Science and Technology, 2019.
- [3] Li Yulu. Research on the Style of Han Official Script in Font Design. Beijing Institute of Fashion Technology, 2021.
- [4] Zhang Shumei. Research on Graphic Design Language Based on Cognitive Psychology. Shaanxi University of Science and Technology, 2012.

- [5] Zhang Mengyan. Research and Design Practice of Mobile Game Anti-Addiction System Based on Color Cognition. Guangdong University of Technology, 2020.
- [6] J. Sweller. Cognitive load during problem solving: Effects on learning. *Cognitive Science*, 1988, 12(2): 257-285.
- [7] Li Xiangyu. Research on the Cultural and Creative Design Strategy of Museums in Nanjing Area from the Perspective of Cognitive Psychology. Southeast University, 2022.
- [8] Wang Ping, Yang Junshun, Sheng Xia. Research on Product Innovative Design Based on Cognitive Psychology. *Art and Design (Theory)*, 2009(02): 163-165.
- [9] Zeng Yichen. Emotional Research on Font Interactive Design under Digital Media. *Art Education Research*, 2023, (24): 93-95.
- [10] Donald A. Norman. *The Design of Everyday Things*. Translated by Mei Qiong. Beijing: CITIC Press, 2003.