



A study of children's book design based on the auditory-tactile interactive experience

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Abstract: Auditory and tactile sensory organs are the important ways for peoples to obtain information from the outside world, as well as the main means for children to feel and recognize new things and acquire knowledge. The design of children's books bears the great social responsibility of educating the future owners of the country, and has a profound social significance. This manuscript explores a new concept and an innovative approach of children's book design in the view of auditory and tactile sensory experiences. The important roles of the auditory and tactile experience in the book design for the children during the sensory sensitive stage is put forward, and the significance of the innovative design of combining sensory experience design with sensory sensitive phase characteristics, in the design of children's books is elaborated.

Keywords: Children's book design; auditory; tactile interaction experience; sensory sensitivity period

I. INTRODUCTION

The book is poetically compared to the ladder of human progress, the key to wisdom, the source of knowledge, the guide of life, and the ship to the other shore. The reputation of books since ancient times is legion. As the symbol of human civilization and the carrier of wisdom, the book plays an important role in every growth stage of all persons.

The childhood is the stage of rapid development of intelligence in a person's life, and it is also the best stage to recognize things and absorb knowledge. According to psychologists, three quarters of intelligence of the person is developed during this period. Children's books accompany children's growth, intellectual development and educational enlightenment. Thus, they are an important medium for the children to recognize the world, and also a key enlightenment tool for the children to acquire knowledge. The development of children's books puts forward higher requirements

for the quality of children's publications. How to stimulate children's interest in reading and help them experience the charm of books from various angles has become a problem of deep concern to book designers.

Maria Montessori [1] summed up various sensitive periods of children, according to their sensitive characteristics to different things at each age-stage through observations, which is helpful to guide the children's book design. Kenya Hara [2] proposed the concept of "information construction", and he emphasized that the graphic design should perceive the information of "vision, hearing, touch, smell and taste" through human brain and convey it to the audience through perfect design. Sugiura Kohei [3] applied "five senses" to book design; he thought the book design was a "story" from a piece of paper, and the book can activate the five senses of knowledge, so as to expand the original single visual experience to multi-sensory experience. David McGookin and Stephen Brewster [4] show how touch and sound can enhance human-machine interaction to help people with different physical and visual disabilities appreciate and understand works in the multidisciplinary viewpoints from psychology to art. With the development of experience economy, the "five senses" design concept has been gradually integrated into the design of children's books [5]. However, many of these existing children's books deliberately pursue sensory experience, and ignore the stimulation of children's "inner potential", as well as lack of consideration of the characteristics of children's sensitive period. Thus, a new design concept of children's book design based on the auditory-tactile interactive experience is raised, so as to stimulate children's interest in reading and promote the development of their inner potential.



II. PHYSIOLOGICAL MECHANISM OF AUDITORY AND TACTILE SENSES

Auditory and tactile sensory organs are two important ways for people to obtain information from the outside world, as well as the main means for the children to feel and recognize new things and acquire knowledge. These sensory systems coordinate the division of labor and cooperate with each other, to promote children's cognition, learning and memory of various things around. Understanding the physiological mechanism and category of hearing and touch, as well as the important role in children's book design, can better realize the sensory experience of vision, hearing and touch in children's book design, and promote the rapid development of children's book design.

2.1 Physiological mechanism of auditory sense

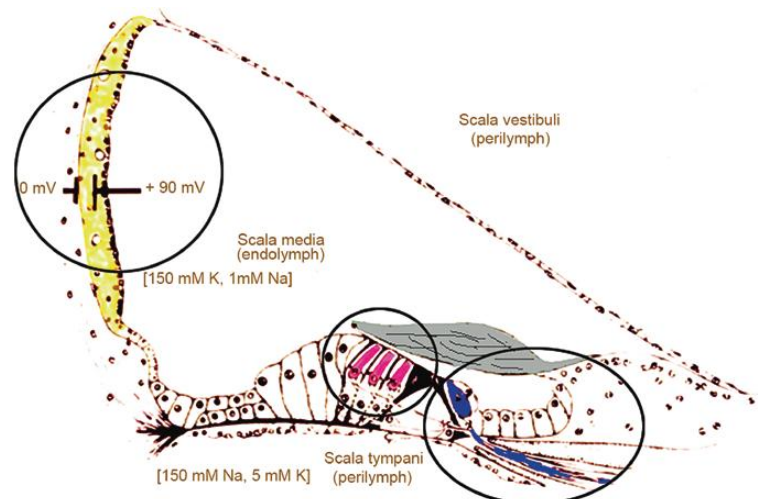


Figure 1 Cross-sectional anatomy of the mammalian single-turn cochlea [6]

The ear is a unique hearing organ of humans and vertebrates. The human ear mainly consists of the outer, middle and inner ears. Figure 1 shows the anatomy of the inner ear cochlea. Cochlear core tissue - corti apparatus converts the signals (sounds) transmitted by the middle ear into matching neural electrical signals, according to specific physiological mechanisms, and further transmits them to the central auditory system, and then realizes hearing [6]. The physiological function of the cochlear in normal mammals can be divided into three interlocking systems: cochlear amplifier, power supply and transduction mechanism, as shown in Figure 1. The cochlear amplifier relies on the activity process of an outer hair cell (OHCs) to physically amplify the traveling wave vibration in

Hearing is the sense of distinguishing sound characteristics, which is an extremely important sensory channel of the human body. The main mechanism is as follows [6]: the external sound waves propagate in the medium and pass through the external auditory canal to the tympanic membrane, causing the tympanic membrane vibration. And then they pass through the auditory ossicle to the inner ear, stimulating the cilia cells in the cochlea to produce the corresponding nerve impulse, which is transmitted along the auditory nerve to the auditory center, and finally forming the hearing. The range of human hearing is generally 20-20,000 Hz, but people's hearing range also varies with age. For example, children can distinguish sound waves from 30,000 Hz to 40,000 Hz, while older people over 50 years can only hear sound waves at 13,000 Hz [6].

the direction of the basal membrane. The discharge is highly dependent on the potential between the ear canal (Scala media) and the drum (Scala tympani). The second system is cochlear power supplies made up of lateral wall tissues, including stria vascularis, which produces endocochlear potential. The third system converts cochlear vibrations into nerve impulses, containing the inner hair cells and afferent fibers of the auditory nerve [6].

2.2 Physiological mechanism of tactile sense

Touch is a kind of skin sensation, which is the sense of recognizing the contact of external stimuli on the skin. In a narrow sense, the sense of touch only refers to the skin sensation generated when some external stimuli interact with the skin's



"tactile receptors". Broadly speaking, the sense of touch also includes the pressure sensation caused by the deformation of the skin under external pressure to a certain extent, which is generally referred to as "tactile pressure sensation"[7]. Tactile sensation is a type of skin sensation that converts external energy into different nerve impulses through the skin's sensory receptors to produce conduction, which in turn leads to the brain. A schematic diagram of skin

sensory receptors is shown in Figure 2. Each of these structures is associated with sensory nerves, free nerve endings are exposed, and branches of dendrites are associated with many skin sensations, including heat. Some dendrite branches of skin receptors, which are covered by related structures such as barbitella, are also receptors for sensing deep pressure.

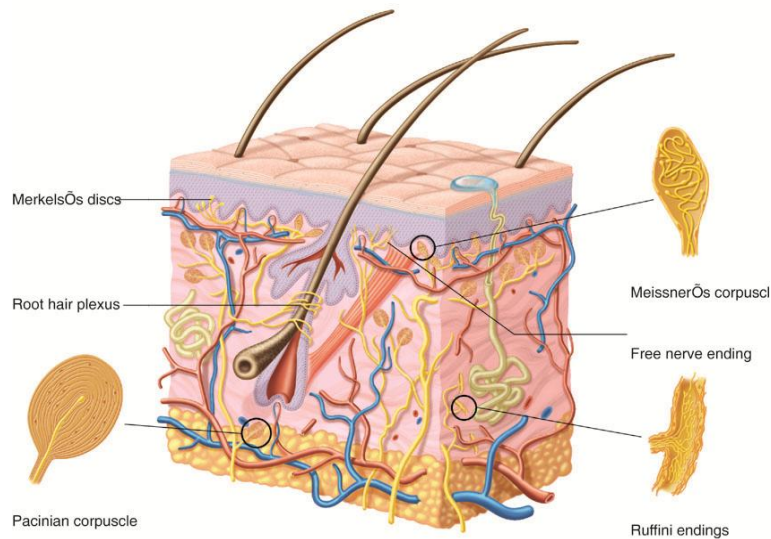


Figure 2 Schematic diagram of skin sensory receptor [7]

The gradient of pressure on the surface of the body is the main stimulus that constitutes the sensation of touch. The surface of the skin has many contact points of different sizes (some up to 0.5mm in diameter) with irregular distribution (most in the abdomen, next in the head, and least in the calf and back). Touch is the body's most complex fifth sense that has rarely been explored and studied, and its important role in human function is beyond doubt. If you want to relax the nervous system, you can stretch. In addition, the sense of touch can increase intimacy, express kindness, and show tenderness and consideration [7]. Therefore, some scholars believe that "when the society ignores the needs of human body and emotional system and lacks the existence of touch, the society will be a morbid society."

III. SENSORY EXPERIENCE CHARACTERISTICS DURING CHILDREN'S SENSITIVE PERIODS

The age stage of the audience group as well as their development characteristics and physiological and psychological requirements, is a question that the children's book designers deserve to be deeply concerned about. The phenomenon and law of children's interest in different things during various age stages is the entry point for children's book design. Based on the work of Montessori, a renowned Italian educator, Figure 3 shows the timetable of various sensitive periods in children aged 0-6 years.

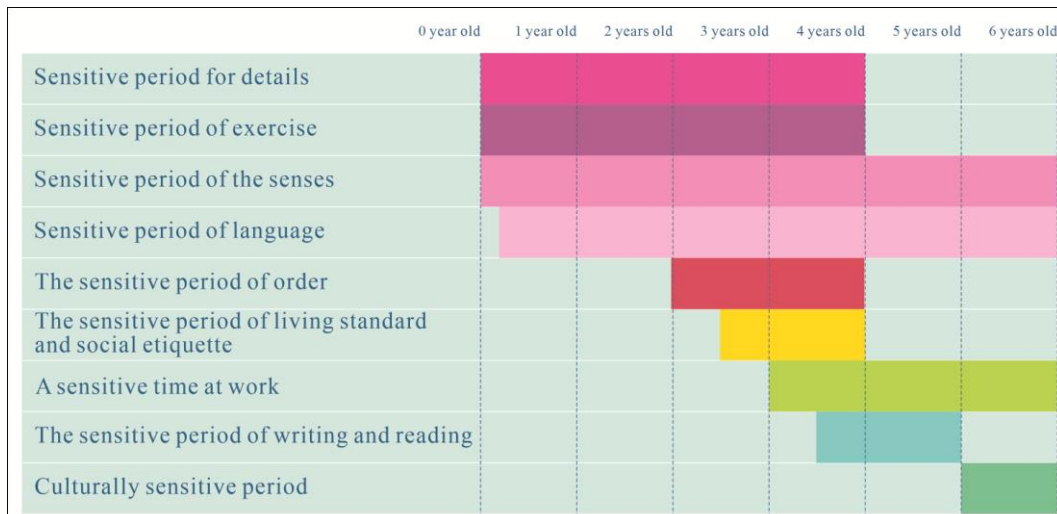


Figure 3 Timetable of various sensitive periods for children aged 0-6 years [1]

Montessori took the lead in putting forward the educational concept of children's sensitive period, that is, appropriate education should be carried out according to the characteristics of children's sensitive period. Sensitive period refers to that children at different stages of development are particularly sensitive to certain things or activities, resulting in a special interest and hobby, so that learning becomes easier and higher education, which becomes the best time for education [1]. In a particular sensitive phase, children have a strong motivation to show their enthusiasm for trying or learning in certain things, and actively trying to absorb contact. Some early childhood educators call this the "critical period" and say it is the best time to develop certain abilities in children. Montessori emphasized many times that the sensitive period is a transient and irreversible psychological phenomenon closely related to the growth of children and corresponding to a certain age, that is, it lasts for a short time and will never reappear once it disappears [1]. Because children can easily and quickly master and acquire certain abilities at different sensitive stages, Montessori suggests that parents, schools or society create or provide appropriate conditions and environments for children at different sensitive stages to enable children to better develop various abilities. Such as 0~4 years old is children's details and movement sensitive period; 2~4 years old is the order sensitive period of children; 2.5~4 years old is the sensitive period of children's social etiquette and life norms; Children aged 3.5~5 are sensitive to writing and reading. 3~6 years old for children work sensitive period; Children's sensory sensitivity period is 0~6 years old.

In the sensitive period of children's ability to develop, their sensory sensitive periods are the earliest. Montessori believes that from the moment young children enter the world, their sensory systems go into action [1]. Fresh air, warm milk bottles, and fine cloth can cause children's psychological reactions. They recognize this new world by watching, listening and touching. But in different age stages, the development of the sensory organ is different.

Children can use five senses to recognize the world from birth. In the sensory sensitivity period, the sensitivity characteristics of children were shown in different shapes and directions, color, high and low volume and identity. If able to give them some corresponding stimulation at this stage, it is conducive to the development of children's feelings and observation forces, and promotes their intellectual development and thinking development [8]. Therefore, the design of the children's book design in the children's group is integrated into more sensory experience design, and the development and intellectual development of children's physical and mental development can be improved by using the five senses to guide the children to receive the things and knowledge they convey in their books.

IV. AUDITORY AND TACTILE INTERACTION EXPERIENCE IN CHILDREN'S BOOK DESIGN

As stated above, children's books are the key enlightenment tools of children's cognition, and have indirect incentives and the role of promoting children's "inner potential". For the students of the four-sex-age-sensitive children's readers in the



sensory sensitive period, the application of auditory and tactile interaction experience in children's books has created conditions for the development of children's senses, and it has been able to ignore the needs of children's psychological development.

Firstly, the application of auditory and tactile interaction experience design in children's book design is rich in the feeling of children and helps to develop its ability to appreciate various subtle stimuli. The multi-sensory experience of children's books will help improve the ability of children. Children's subtle and rich feelings can help them find the endless source of beauty in their lives.

Secondly, the auditory and tactile interaction experience design in children's books can improve the ability of children to explore, help children become good observers and better prepare for actual life. Children's books, from the various aspects of vision, hearing and touch, will help children to fully understand things in many ways, indirectly cultivate the habits of children's careful observation, promote the development of the senses, and make their senses more acute, and prepare for their future daily life and social life. There have been experiments to show that the reason why adulterated food can blind many consumers is because most people feel dull.

Thirdly, the auditory and tactile interaction experience design in children's books follows the development of children. The sensory sensitivity of the six-year-olds is encouraging them to choose from a complex environment, which is appropriate for their own growth, which can make children's sensory sensitive things a child's whole world. Children are not only interested in these things themselves, but also have the unique potential to use these things to develop their own.

Fourthly, the auditory and tactile interaction experience design of children's books attracts children's attention, so that children's eyes, ears, hands and other senses coordinate the division of labor, together to promote children's perception of graphics, things, etc., to make children's impression of things more clearly, accurate and pure, and will help to keep the perceived graphics or things in memory.

Fifthly, the auditory and tactile interaction experience design in children's books has exercised the sensitivity of children and developed their ability to identify voices.

V. SUMMARIZE

Children's books based on multiple sensory experiences, such as sight, hearing and touch, are

not only helpful for helping children to understand things, to understand text content, but to improve the value of books themselves, so that books can stand out in similar books. The children are able to read through the eyes, ears and hands. The common stimulation of the eye, ear and hand is that the small reader will be able to enjoy the beauty in the course of reading, and be excited and satisfied in the spirit. The design of children's books in the auditory and tactile interaction experience, not only to create imaginary reading space for children, but also to stimulate the strong reading desire of children. Auditory and tactile interaction experience of children's book design helps children understand and understand the world in a wide range of ways.

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