

Related Influencing Factors of Deaf People's Facial Emotion Recognition

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Abstract: Facial emotion recognition plays an important role in daily communication and plays a key role in social adaptation and personal development. Emotion recognition ability is an important component of non-verbal communication system, and it is also a necessary skill to successfully adapt to and deal with environmental problems. A large number of studies have examined the differences in facial expression recognition between deaf and hearing people. Research has proved that deaf people face emotion recognition has different degrees of difficulty, which is manifested in the deaf people's recognition emotion type accuracy rate and reaction time lower than that of healthy people. Deaf people face emotional recognition difficulties are affected by physiological and social environmental factors. Based on these physiological and environmental factors, helping the deaf improve their facial and emotional recognition ability can help improve their social adaptability.

Keywords: Faces; Emotions; Emotion Recognition Deaf

1. Introduction

Emotion recognition plays an important role in understanding other people's intentions in daily life communication. Expression and recognition of emotional information by animals and humans play a key role in the process of adapting to the environment[1]. Emotion recognition is an important part of human nonverbal communication system, and it is also a necessary skill to successfully adapt and deal with environmental problems. As a basic skill to adapt to and succeed in interpersonal relationships, recent studies believe that emotional recognition ability is definitely related to psychopathological disorders. Face emotion recognition is one of the types of emotion recognition, that is, the process of recognizing the emotional state of others through facial features. Abnormal facial emotion recognition is considered to be the key factor of poor communication and changing adaptive behavior[2]. Difficulties in face and emotion recognition can hinder interpersonal communication and even affect lifestyle. Therefore, it is very important to explore the internal cognitive factors that affect deaf people's face emotion recognition difficulties, and to provide theoretical basis for deaf people's face emotion recognition ability training based on the previous research results.

China is a large country with a large population, and the special population also accounts for a considerable number. According to the census data of the disabled population, by the end of 2010 there were 2054 ten thousand people with hearing disability. They suffered hearing impairment to varying degrees due to various reasons, thus changing their lifestyle to a certain extent. According to the theory of brain plasticity, certain sensory impairment (e.g. hearing) can develop more advantageous sensory functions (e.g. vision) in other brain regions. So is deaf people more visually advantageous? Existing research shows that visual stimulation can activate the corresponding auditory cortex, and deaf people have advantages over normal people in visual stimulation search and visual receptivity[3]. Some researchers have also examined deaf people's face perception ability, and the results also prove that deaf people's correct rate in target face matching task is higher than that of healthy hearing people's control group[4]. However, a large amount of current research evidence shows that deaf people have different degrees of defects in the process of face emotion recognition, which are mainly manifested in the recognition of different emotion types and in the process of different emotion recognition tasks. Most and others use emotion recognition test (EMOTIONIDENTIFICATION TEST, EIT). Through facial

emotion recognition of different sensory channels of 40 participants, it is found that deaf children's auditory, visual and audio-visual channel recognition ability is lower than that of healthy children. Research also shows that facial emotion recognition is related to hearing impairment. The higher the hearing, the stronger the facial emotion recognition ability [5]. The research of Ludlow and others on 72 children found that deaf children's emotion recognition ability to female actors was significantly lower than that of the control group [6]. The experimental results of Wang and et al on 16 deaf children using cochlear implants or hearing aids to recognize facial emotion pictures show that deaf children's facial recognition ability is also lower than that of healthy hearing children [7]. Therefore, why has the visual processing advantage of the deaf disappeared in the recognition of facial emotion? Is the special nature of emotion causing them to have difficulty in processing this? There is still no clear explanation.

The traditional research mainly studies deaf people's facial emotion recognition from the perspective of physiological or social environment. The physiological perspective thinks that deaf people's facial emotion recognition is mainly due to the changes of brain neural mechanism, which leads to the defects of deaf people's facial emotion recognition. The social perspective believes that this kind of defect is caused by the social living environment of deaf people, such as less communication, lack of language skills, difference in parental education level. But physiological and social environmental factors are interactive, so the defect of deaf people's facial emotion recognition may be the result of the interaction of the two.

2. Research on Physiological Factors Affecting Deaf People's Facial Emotion Recognition

2.1 Influence of Age

Age is one of the important factors of facial emotion recognition ability. Some basic human facial emotions can be recognized in infancy. With the continuous development of age, facial emotion recognition ability is also continuously improving. So how does facial emotion recognition improve with age? Early research found that in 4, 6, 8 the proficiency of facial emotion recognition of children aged [8]. "increased with age. Dyck and Emotions Recognition Scales, ERS were used to investigate participants aged 6-18. The results show that deaf children have lower recognition ability to ERS and ERS than deaf teenagers" [9]. It means that the ability of emotion recognition is affected by age, but Ludlow and others use human faces of real people, cartoons and cartoons to recognize deaf children. The results show that in deaf children whose age span is 10, their ability to recognize faces and emotions has not changed significantly with age [10]. This is in conflict with the previous conclusion that facial emotion recognition ability increases with age. The possible reason is that the age span is large in the Ludlow study, and the number of participants in the study is limited (26 name). The previous results are supported by the study on the age factors of facial emotion recognition using event-related potential technology. The study shows that the P1 component appears in adolescents, while the P1 component disappears in adults and is replaced by the N170 component. Children and adolescents show differences in facial emotion processing in the early processing stage of facial emotion, and the adult mode of facial emotion processing only appears in the late adolescence [11]. Early ERP Component Differences Suggest Different Visual Processing Mechanisms. In short, through the comprehensive analysis of relevant research on different age groups, we can see that deaf people of different ages have differences in facial emotion recognition ability, which is manifested in the corresponding improvement of facial emotion recognition ability as they grow older.

2.2 Effect of Attention Bias

With the development of science and technology, the current research has studied deaf people's face emotion recognition through brain imaging and event-related potential technology. The physiological perspective believes that the defects of deaf people's facial emotion recognition are caused by changes in relevant parts of the brain, which first come from the visual processing mechanism. Previous research evidence shows that people have left visual field deviation

(leftviewfield, LVF) in the process of observing faces, and the corresponding cortical areas in the right hemisphere of the brain have more advantages in the response to face stimulation[12-13].

This means that face processing has specific brain regions, and changes in these brain regions may affect face emotion recognition. Early studies found that deaf and hearing impaired sign language users are faster and more accurate in right visual stimuli than in left visual stimuli, but slower in hearing impaired non-sign language users[14], which indicates that the learning and use of sign language may change the original brain regions and lead to individual visual bias. Letourneau et al. proved that deaf people not only pay attention to the existence of emotions but also pay attention to faces when they pay attention to facial emotions through emotional judgment tasks in left and right visual fields, thus reducing the left visual field deviation (LVF) of deaf people when dealing with facial emotions [15-16].

This also shows that deaf people pay more attention to the overall processing of faces when observing facial expressions, which may also increase the burden of deaf people on emotional processing of faces. But deaf people have up-and-down deviations in face emotion recognition tasks[17], Research shows that deaf people pay different attention to the eye area and the mouth area.

The eyes are usually regarded as the window of the heart and play an important role in interpersonal communication, but deaf people have a habitual fixed pattern to collect information from facial expressions to the maximum extent[18]. Blais and others found that the mouth region is the most important clue of static and dynamic expressions through the study of eight kinds of static and dynamic expressions[19]. Mitchell and others used the emotional picture judgment task of dislocated faces to horizontally divide a face into upper and lower parts from the nose, and then put the two parts together in dislocation to judge whether the upper and lower parts come from the same face. The results show that the hearing people have the same judgment accuracy for the upper and lower parts of the task, but the deaf people have higher judgment accuracy for the lower part than the upper part[20]. This means that deaf people are more inclined to process the lower part of the face, but deaf people's attention preference to the lower part seems to be limited to face pictures. He and et al.'s research on the upper and lower attention preference of faces and house pictures show that deaf people show a smaller reversal effect on the lower part of faces, the mouth region, and this effect does not appear in pictures of houses, which shows that faces have particularity[21]. In addition, due to the defects of deaf people's facial emotion recognition ability, it is generally believed that deaf people will have more reversal effects when dealing with inverted faces than healthy people. However, if deaf people process face information more visually than audibly, this effect will be reduced. said.

De and et al.'s research also prove that deaf people have reversal effect in face processing, but not in non-face processing, and deaf people show smaller reversal effect compared with healthy hearing people[22]. Suggests that deaf people rely more on visual processing due to hearing impairment. The latest research finds that deaf people have higher accuracy in a series of target face matching tasks than healthy hearing people, indicating that deaf people have general visual processing advantages rather than special face effects[23]. These research evidences show that deaf people have developed more advantageous visual processing ability due to hearing loss in different degrees, but this visual processing ability only exists in general visual processing instead of facial emotion processing. Therefore, deaf people have not increased their ability to recognize faces and emotions because of their superior visual processing mechanism. Most and others studied 26 deaf children using emotion evaluation tasks. They were asked to identify various emotions expressed by stars through three conditions (visual, hearing, audio-visual sense). The results also showed that the accuracy rate of deaf children in the process of emotion identification was significantly lower than that of normal children[24]. However, the condition of joint audio-visual perception is better than that of single channel in emotion recognition, which indicates whether deaf people use hearing aids to recognize facial emotion using auditory information, and the use of hearing aids will not increase their ability to recognize facial emotion. Deaf people have difficulty in recognizing other people's faces and emotions. Researchers also examined the ability of deaf people to recognize their own emotions. The results show that deaf people have no difficulty in recognizing their basic emotions, but deaf people show a reduced ability to distinguish their own negative emotions[25].

2.3 Effects of Brain Activation Regions

Brain parts involved in emotion recognition include occipital lobe, amygdala and ventral fusiform gyrus. Occipital visual cortex includes fixation region and facial processing adjustment to help other core regions extract facial information. The amygdala plays a central role in processing social information related to the face, especially threat-related information[26]. Fusiform gyrus is a special part involved in face perception[27]. In addition, the study believes that the activation of the superior temporal sulcus (superior temporal sulcus, STS) in emotional expression activities is the right hemisphere in healthy hearing people, while deaf people activate the bilateral brain regions. "Deaf people activate left brain regions in fusiform gyrus (fusiform face area, FFA), while healthy hearing people activate bilateral brain regions[28]. This shows that there are differences in activation of corresponding brain positions in the process of dealing with corresponding facial emotions between the hearing impaired and the deaf, which are manifested as different lateralization. Event-related potential study found that deaf and hearing impaired sign language users had obvious activation in the left hemisphere, while hearing impaired people had obvious activation in the right hemisphere[29-30]. Similar lateralization effects can also be found through the N170 component. Studies show that there are differences in brain regions activated when hearing-impaired people and deaf people watch facial emotions. Mitchell et al. studied the changes of brain potentials of healthy hearing people and deaf people in observing different types of materials, and found that healthy hearing people cause right hemisphere lateralization but deaf people do not have this phenomenon. The researchers also believed that the result of this effect was formed by long-term use of American sign language instead of hearing loss itself through data analysis of five natural sign language users[31]."

An opposite view holds that deaf face emotion recognition is affected by hearing loss itself. The study explored whether deaf people activate auditory cortex during face processing, Stropahl and others performed face recognition tasks on cochlear implant objects. The results showed that the activation of right auditory cortex of cochlear implant objects was significantly higher than that of healthy hearing people[32]. The study also found that cochlear implantation does not seem to increase deaf people's ability to recognize faces and emotions[33]. This shows that deaf people may not improve their facial emotion recognition ability with the help of cochlear implant, and their emotion recognition ability may be limited by hearing impairment itself rather than the environment. Recent research supports the conclusion that deaf people who use cochlear implants or hearing aids have difficulties in emotional naming (language) or facial emotion matching (non-language) tasks[34].

These two opposite viewpoints may be caused by other reasons. Previous studies have mostly used static facial emotion pictures as experimental materials, which are not quite consistent with social interaction in daily life. Static pictures may have some deviation on deaf people's facial emotion recognition. The study found that deaf people's ability to recognize dynamic faces and emotions is better than static faces, while healthy people show no difference in these two conditions[35]. Deaf children have higher accuracy in naming facial emotions than healthy hearing children. However, healthy hearing children and deaf children show confusion on negative facial emotions, such as anger and disgust, fear and sadness[36]. In order to avoid this situation and make the research closer to reality, Grossman and others used six kinds of dynamic emotional materials to investigate the classification of deaf people and healthy people. The results also showed that the accuracy of deaf people's emotional classification was significantly lower than that of healthy people[37]. Adult studies have found the dynamic advantage of facial emotion recognition, that is, the ability to recognize dynamic facial emotion is stronger[38]. Neuroimaging Studies Found Increased Activity in Social-Related Upper Temporotemporal Ditch (STS) and Emotion-Related Amygdala (Amygdala)[39]. However, recent research has found that healthy listeners also lack dynamic advantages when face emotional intensity is high[40]. It is worth noting that in their research, most participants have no time limit when identifying various emotions, so participants may spend a lot of time in the identification process to make choices, which may affect the interpretation of the results. In a word, both static and dynamic recognition materials show that deaf people have difficulties in face emotion recognition. The brain activation level indicates that the structural difference of the brain is indeed one of the factors that affect face emotion recognition ability.

3. Environmental Factors Affecting Deaf Face Emotion Recognition

3.1 Influence of Language Environment Factors

Previous studies believe that deaf people's facial emotion recognition ability is affected by age, Language skills and social interaction relationship. Language skills (all the languages mentioned later refer to the vocabulary and grammar of the healthy listener, not sign language skills) should be considered as an important factor. Most of the information received in early childhood comes from non-language information. The biggest impact of hearing loss on language development is the development of spoken language. Almost all deaf people do not have standard spoken pronunciation. This is because they cannot get correct and effective feedback in the process of oral expression after hearing loss. The research results of Dyck, People Use and ERS show that after matching participants with Wechsler Language Scale, deaf people's recognition ability on ERS is equivalent to or even higher than that of the control group. This shows that deaf face emotion recognition is affected by language skills[41]. Deaf people's difficulty in recognizing faces and emotions is usually explained by the theory of mental defects (TheoryFMIND, Tom) [42]. "ToM is divided into two aspects of social cognition and social perception, and these two aspects can be separated, in other words, individuals with equivalent social cognition may have differences in social perception". ToM thinks that after matching intelligence, there are still difficulties in face and emotion recognition, which indicates that the difficulties in face and emotion recognition of deaf people are not caused by social cognition, but by social perception. Through the study of facial emotion recognition between sign language users and spoken language users, the results show that there are differences in the activation of the superior temporal sulcus when they recognize facial emotion[43]. This means that the learning of sign language changes the activation of the brain.

On the other hand, early language stimulation plays an important role in the early stages of personal development, while parent-child communication plays a major role in language learning. Parents are the main imitators of children in their early years, and at the same time they can get a lot of important information from their parents. Except for hereditary deaf children, most of the parents of deaf children are healthy listeners, or at least one of them is a healthy listener. The parent-child communication between parents of such families and deaf children is often restricted. Most deaf children's parents who are able to hear do not use sign language. Therefore, most deaf children cannot use sign language before receiving school education, which also limits the early social development of deaf children. The development of language comes from social communication activities. Deaf people's social communication is restricted, and the development of language ability is also restricted[44]. Studies have shown that language is related to emotion recognition, Rieffe, and others have found that children with language disorders are similar to the control group in recognizing nonverbal emotion recognition, but lag behind the control group in naming tasks of joy, sadness, anger, fear, and the results of naming tasks are also related to their language proficiency[45]. "The study found that children aged 3-8 showed defects in face emotion recognition and emotional naming tasks, but the defects only existed in fear, surprise, and disgust, rather than happiness, sadness, and anger." This result shows that even when age is controlled, language skills and facial emotion recognition ability are still correlated[46]. On the contrary, some studies have found that there is no difference in emotion recognition ability between deaf and healthy people. Ziv uses a series of color emotion pictures as a material for children aged 5-7 years to examine the recognition ability of deaf people. The results show that there is no difference in 6 facial emotion between deaf and deaf cochlear implant children and control group[47]. In order to investigate whether cochlear implant can help deaf people acquire more language skills.

Thus improving facial emotion recognition ability. Mancini studied the relationship between language level, gender and hearing loss severity of deaf people with cochlear implant at different ages. the results showed that deaf children with cochlear implant time within months of birth 18 have better emotion recognition ability[48].

Cochlear Implants (CochlearImplants, CIs "CIS") are more commonly used in Western Westerners[49-50]. It is a surgical operation to improve bilateral sensory nerve damage[51], which uses electricity to stimulate deaf people's auditory nerve and help deaf people perceive sound. A series of studies show that cochlear implantation improves the language skills of deaf children in depth[52-54]. Deaf children's language ability has nothing to do with the use of sign language before and after cochlear implantation, that is, early sign language learning will not improve the language ability of deaf children after cochlear implantation. Conversely, deaf children who did not learn sign language early gained better verbal

ability after 3 years of cochlear implantation, and were significantly better at speaking and reading than those who accepted sign language[55]. What is worth noting here is whether sign language learning helps deaf people's speech development or hinders normal language development? This also shows that deaf people's face emotion recognition ability may be disturbed by early sign language learning.

3.2 Influence of Cultural Environmental Factors

The influence of culture on facial emotion recognition is mainly manifested in the understanding and expression of native or alien emotions. Culture has diversity and difference, not only between eastern and western cultures, but also within the same culture. For example, Japanese people think negative emotions are a sign of cowardice, so their culture expresses less negative emotions[56]. At the same time, Japanese use more facial expressions in daily life than westerners, so they are more influenced by facial emotions in social background than westerners[57]. Previous researchers have conducted cross-cultural research on emotion recognition, showing that the accuracy of face emotion recognition ability is higher for the same country or groups with high similarity[58]. That is, the ability of our own people to recognize faces and emotions of our own people is better than that of our own people to recognize faces and emotions of other people[59-60], which indicates that there is an alien effect in face and emotion recognition (cross-race effect, CRE). It is also possible that there is a difference in the way people process faces and emotions between the East and the West.

Caldara et al. observed the eye movements of eastern and western people when dealing with face tasks, and found that western people focused on fixed areas of eyes and mouth while eastern people gave priority to the middle part of face. In addition, westerners rely more on mouth features while easterners rely more on eye features in face emotion recognition tasks[61]. Eastern and Western cultures influence people's attention bias to face processing, which shows that the way people process face information is influenced by past experience and cultural environment. Cross-cultural studies on deaf people's facial emotion recognition are relatively few. By comparing relevant studies on deaf people's facial emotion recognition in different countries and cultures, it is found that deaf people's facial emotion recognition may also be influenced by culture. The differences between the eastern and western cultures on the face recognition of deaf people are classified, and the face emotion recognition of deaf children is mainly more in China. Wang and others in 2011 and 2016 respectively have the same results on the face emotion recognition of deaf children in Beijing. The results show that deaf children have better ability to recognize happy faces than sad faces, and it is the most difficult to recognize fear emotions[62-63]. On the contrary, foreign studies have reported that deaf children's ability to recognize sad faces is better than happy faces, but the recognition of fear is still the most difficult[64-65]. There are also research reports that different tasks may have different recognition differences. For example, fear is the most difficult to recognize in the emotion naming task, but fear is the most easy to recognize in the emotion matching task, which is exactly opposite to the above research results of Wang and others. Generally speaking, deaf children in both East and West cultures scored lower in identifying fear than other emotions. The main difference in identifying emotions is between happy and sad emotions. Deaf children in China are more likely to identify happy emotions, while deaf children in the West are more likely to identify sad emotions. Of course, these studies do not use common research paradigms and experimental materials, and there are many reasons for this difference. It can only be inferred from the existing literature conclusions that there may be cultural differences in deaf face recognition, which also requires further research to confirm whether deaf people also have alien effects when recognizing emotional faces.

4. Inspiration and Prospect

To sum up, a large number of researches have confirmed the defects of deaf people's facial emotion recognition ability. Although the research uses different methods and approaches from different aspects and different age groups as indicators, most of the researches agree that deaf people have differences in facial emotion recognition ability with healthy listeners, which is manifested in the difficulty of deaf people's facial emotion recognition. This difference is mainly aimed at different facial emotions and different experimental materials. Facial emotions mainly think that deaf people have

difficulty in recognizing negative emotions, and the materials show different experimental materials (faces or non-faces; Positive or inverted faces, etc.) show the difference of deaf people's emotional recognition. Although the difficulty of facial emotion recognition of the deaf has been basically determined, there are still some doubts, that is, what causes the difficulty of facial emotion recognition of the deaf and whether there is any way to restore it have not yet been confirmed. In addition, many studies only focus on the difficulties of deaf people in recognizing facial emotion, and few studies examine what the visual advantages of deaf people embody in facial emotion recognition, which is worthy of careful consideration .

In addition, previous research evidence shows that deaf people face emotion recognition is influenced by age, emotion type and language development factors, especially deaf people have difficulty in recognizing negative emotions such as fear, aversion, and the corresponding cognitive theory is put forward. Therefore, in the future deaf education, it is necessary to create realistic situations to help deaf people learn face negative emotions and vocabulary negative emotions, to help deaf people better adapt to social communication activities, and to improve deaf people's ability to correctly identify other people's emotions and to correctly express their emotions. On the other hand, it is necessary to pay attention to the development of deaf people's speech skills. The slow development of deaf people's speech skills not only affects their ability to recognize faces and emotions, but also affects their social cognitive ability. Therefore, timely training of deaf people's language skills can help deaf people develop better social cognitive ability. Finally, according to the characteristics of deaf people's ability to recognize positive faces and emotions is higher than that of negative faces, teachers can use more positive emotions to teach and promote deaf people's interest in learning. Future research can be further explored in the following aspects.

Firstly, we can consider examining the physiological differences of deaf people's facial emotion recognition from the perspective of integration of physiological and social factors, and at the same time, we can also consider the influence of the social environment of deaf people's life on them. Secondly, from the aspect of social environment, whether helping the deaf to change the social environment can also improve the ability of the deaf to recognize faces and emotions needs further empirical investigation. Thirdly, whether deaf people's facial emotion recognition ability is affected by early social communication activities, language ability training, and cultural background requires further verification by researchers in the future.

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