The Influence of Sensory Information Processing on Emotional Cognition: Exploring from the Perspective of Multimodal Sensory Channels

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Abstract: This article focuses on the influence of sensory information processing on emotional cognition under multimodal sensory channels. At present, the academic circles have not fully understood this, and some studies focus on a single channel or lack of mechanism discussion. From the perspective of multimodal sensory channels, this article first expounds the theoretical basis of multimodal sensory channels and emotional cognition, covering the concept classification of multimodal sensory channels, cognitive theory of emotion and their correlation theory. Then, it analyzes the influence of sensory information processing on emotional cognition in different modal sensory channels such as vision, hearing, touch and smell. Through theoretical analysis, examples and experimental data (investigation and experimental results of the influence of different intonation speed and different sensory channel combinations on emotional cognition), this article comprehensively analyzes the effect of sensory information processing on emotional cognition under multimodal sensory channels. It is found that the integration of multi-modal sensory channels, information interaction between different channels and individual differences all have an important impact on emotional cognition, which provides new ideas and theoretical support for theoretical development and related applications in the field of emotional cognition.

1. Introduction

In the complex cognitive system of human beings, emotional cognition is an extremely important part. It affects the individual's decision-making, behavior and social interaction [1]. In recent years, with the development of cognitive science, psychology and other disciplines, the relationship between sensory information processing and emotional cognition has been widely concerned [2]. As the initial input of the interaction between individuals and the external environment, the processing of sensory information plays an important role in emotional cognition [3].

From the perspective of multimodal sensory channels, the information received by different sensory channels, such as vision, hearing, touch, smell and taste, undergoes complex processing in the brain, which further affects the individual's perception, understanding and expression of emotions [4]. For example, the processing of information such as color and facial expression in the visual channel and the processing of information such as tone and timbre in the auditory channel may have different degrees of influence on emotional cognition [5]. Different sensory channels do not work in isolation, and there are complex interactions and integrations between them. The influence of sensory information processing under this multimodal sensory channel on emotional cognition is more complex and critical [6].

However, at present, there is no systematic and comprehensive understanding of how sensory information processing affects emotional cognition through multimodal sensory channels [7]. Some studies only focus on a single sensory channel, ignoring the interaction between multimodal; Although some other studies are involved, there are still some shortcomings in mechanism discussion [8]. Based on this, this article aims to explore the influence of sensory information processing on emotional cognition from the perspective of multimodal sensory channels, hoping to reveal the potential laws and mechanisms, provide new perspectives and ideas for theoretical

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development in the field of emotional cognition, and also provide theoretical support for related application fields.

2. The theoretical basis of multimodal sensory channels and emotional cognition

Multi-modal sensory channel refers to the way that human beings perceive and process external information through various sensory channels. Generally speaking, it can be divided into five basic sensory channels: vision, hearing, touch, smell and taste. Visual channel mainly receives light information, so that individuals can perceive the shape, color and spatial position of objects. The auditory channel is responsible for processing sound signals, including speech and environmental sounds, and providing people with important auditory information [9]. Touch senses pressure, temperature, vibration and other stimuli through skin receptors, and transmits the information of contact between the body and the outside world. The sense of smell recognizes odor molecules by olfactory receptors in the nasal cavity, while the sense of taste recognizes different tastes by taste buds. The latter two often work together to affect individuals' perception of the environment and food.

Cognitive theory of emotion believes that emotions are not directly triggered by external stimuli, but the individual's cognitive evaluation of stimuli plays a key role [10]. For example, Arnold's "evaluation-excitement" theory emphasizes that emotional production depends on the evaluation of the situation. Lazarus further developed this theory and put forward the theory of cognition-evaluation, which holds that emotion is the product of the interaction between man and environment, and individuals produce emotion by constantly evaluating the relationship between stimulating events and their own interests. These theories emphasize the core position of cognitive process in emotional production and provide an important framework for understanding emotional cognition.

Sensory information processing is the basis of emotional cognition. After sensory information is introduced into the brain through sensory channels, it needs complex processing to affect emotional cognition [11]. When an individual sees an angry face (visual sensory information), the brain will process the information such as feature extraction and recognition, and then judge the emotional meaning conveyed by the face and trigger corresponding emotional cognition. Relevant theories point out that the speed and accuracy of sensory information processing and the degree of information integration in different sensory channels will affect the results of emotional cognition. This connection reveals the internal relationship between sensory input and emotional cognition, which lays a theoretical foundation for further discussion on the relationship between them.

3. Influence of sensory information processing on emotional cognition in different modal sensory channels

3.1. The influence of sensory information processing in visual channels on emotional cognition

As an important sensory channel for human beings to obtain external information, vision conveys rich and diverse information. The processing of visual elements such as color, shape and facial expression has a profound influence on emotional cognition. Red is often associated with emotions such as enthusiasm and danger, while blue is considered to be related to calmness and sadness. In facial expression recognition, when an individual sees a smiling face, the visual system will quickly capture the characteristics such as the corners of the mouth rising and the eyes narrowing. After the brain processes these information, the individual will recognize positive emotions. Studies have shown that people recognize fear expressions faster than other expressions. This is because the expression of fear contains the characteristics of big eyes and wide mouth, which is easier to be quickly captured and processed by the visual system, thus triggering the individual's emotional cognition of potential danger.

3.2. The influence of auditory channel sensory information processing on emotional cognition

The sound information received by auditory channels also plays an important role in emotional

cognition. Tone of voice, speech speed and music are all key factors affecting mood. For example, cheerful music rhythm usually causes cheerful mood, while low and slow music may make people feel sad. In daily communication, the angry tone of the speaker will make the listener quickly perceive negative emotions. The investigation results of the influence of different intonation and speech speed on emotional cognition are shown in Table 1. The survey selected 100 participants to listen to sentences with different intonation and speech speed, and recorded their emotional cognition. As can be seen from the table, most participants recognize fast and high-pitched sentences as excitement or anger; While slow and low-pitched sentences are thought by most participants to convey sadness or calmness. It can be seen that the processing of auditory channel sensory information has a significant impact on emotional cognition.

Table 1 Survey Results on the Impact of Different Intonations and Speech Rates on Emotion Recognition

Intonation and Speech Rate	Number Recognized as Excited	Number Recognized as Angry	Number Recognized as Sad	Number Recognized as Calm
Fast and High-Pitched	42	35	5	18
Slow and Low-Pitched	8	6	45	41
Fast and Low-Pitched	22	28	15	35
Slow and High-Pitched	15	12	30	43

3.3. Influence of sensory information processing of other sensory channels (touch, smell, etc.) on emotional cognition

Touch also has a certain influence on emotional cognition through skin contact with external stimuli. Soft touch can often bring a feeling of comfort and peace of mind, while rough or strong touch may cause discomfort and irritability. For example, in infancy, the mother's gentle touch helps the child to establish a sense of security, which reflects the shaping effect of tactile sensory information processing on emotional cognition.

In the sense of smell, different smells can evoke different emotional memories and cognition. The fragrant flowers often make people feel happy, while the pungent smell may lead to disgust. For example, the smell of disinfection water in hospitals may remind patients of illness and pain, thus causing anxiety. Although tactile and olfactory channels receive limited information compared with visual and auditory channels, they are equally indispensable in the process of emotional cognition, and interact with other sensory channels to jointly construct an individual's complete cognition of emotions.

4. Comprehensive analysis of the influence of sensory information processing on emotional cognition under multimodal sensory channels

4.1. The mechanism of the influence of multimodal sensory channel integration on emotional cognition

Multi-modal sensory channels do not act independently on emotional cognition, but integrate with each other to jointly shape individual emotional experience. The brain will fuse and analyze the information from different sensory channels to form a more comprehensive and accurate emotional cognition. When watching a horror movie, the visually gloomy scene and the auditory scary sound effect cooperate with each other, which strengthens the audience's fear. This integration mechanism is based on the complex neural pathways in the brain, and there are extensive neural connections between different sensory areas, so that information can be transmitted and interacted

with each other. Through this integration, the influence of sensory information processing on emotional cognition is more intense and lasting.

4.2. The performance of information interaction of different sensory channels in emotional cognition

The interaction of information from different sensory channels has rich forms in emotional cognition. Taking the restaurant environment as an example, the aroma of food (smell), exquisite dishes (vision) and soft background music (hearing) jointly create a pleasant dining atmosphere and enhance diners' positive emotional cognition. In order to further explore this interaction, this article conducted an experiment and sorted out Table 2. In this experiment, 150 participants were selected and divided into different groups, which were exposed to different sensory channel combinations, and then their emotional cognition was evaluated. According to the data in the table, when the three sensory channels of vision, hearing and smell are positive at the same time, the proportion of participants who have positive emotional cognition is as high as 85%; However, when one of the sensory channels is negative, the proportion of positive emotional cognition decreases significantly. This clearly shows the important influence of information interaction of different sensory channels on emotional cognition.

Table 2 Experimental Results on the Impact of Different Sensory Channel Combinations on Emotion Recognition

Sensory Channel Combination	Proportion Recognized as Positive Emotions	Proportion Recognized as Negative Emotions
Vision + Audition + Olfaction (All Positive)	85%	15%
Vision + Audition (Positive) + Olfaction (Negative)	40%	60%
Vision (Positive) + Audition (Negative) + Olfaction (Positive)	35%	65%
Vision (Negative) + Audition + Olfaction (Positive)	30%	70%

4.3. The role of individual differences in the influence of multimodal sensory channels on emotional cognition

Individual differences play a key role in the influence of multimodal sensory channels on emotional cognition. Different individuals have different processing and emotional cognitive responses to the same sensory information due to different factors such as heredity, life experience and cultural background. For the same sad piece of music, musicians may have a more subtle and profound understanding of the emotions conveyed in music because of their professional training; The emotional response of ordinary people may be relatively shallow.

Cultural background also has a significant influence. In some cultures, a specific color or smell may have a unique emotional symbol, and individuals with different cultural backgrounds have completely different emotional cognition. These individual differences make the influence of sensory information processing on emotional cognition under multimodal sensory channels more complex and diverse, which needs to be fully considered in research and application.

5. Conclusions

This article focuses on the influence of sensory information processing on emotional cognition under multimodal sensory channels. By combing the relevant theoretical basis, the basic concepts of multimodal sensory channels and emotional cognition and their correlation are clarified. In terms of the influence of different modes of sensory channels, vision, hearing, touch and smell each have a profound effect on emotional cognition by virtue of their unique information processing methods.

The comprehensive analysis shows that the integration of multimodal sensory channels has a M

significant impact on emotional cognition, and the information interaction of different sensory channels is rich, diverse and key. Multi-channel information in the restaurant scene jointly creates an emotional atmosphere, and the experimental data intuitively shows the differences in the influence of different channel combinations on emotional cognition. At the same time, individual differences play an important role in it, and factors such as heredity, experience and cultural background lead to different emotional cognitive responses of individuals to the same sensory information.

This study reveals the potential law and mechanism of sensory information processing affecting emotional cognition under multimodal sensory channels. It provides a new perspective for the theoretical development in the field of emotional cognition, breaks through the limitations of previous single-channel research, and enriches the cognition of multi-channel interaction.In the art and design industry, these findings illuminate application prospects such as enhancing emotional resonance in interactive installations, crafting multisensory spatial experiences, and optimizing user engagement through sensory hierarchy design. Future research could focus on how individual aesthetic preferences modulate multimodal perception, and explore sensory integration strategies in immersive art environments or augmented reality design systems.

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