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Research on Emotional Cognition of Abstract Art Painting in Continuous Flash Suppression

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----------***ABSTRACT***----------
It is a long-term debate about how people perceive the emotional perception of artistic painting. Some artists and theorists claim that certain characteristics of painting, such as color, line, and content, can always express an objective emotion. In this regard, we did three studies; first, we established an abstract art painting data set, including geometrical abstract paintings and expressionist abstract paintings as well as the inverted images of these paintings. We analyzed the observer's four different abstract art paintings. Secondly, I use the continuous flash suppression paradigm to study the time for the subconscious observer to break through the inhibition of the four types of paintings; finally, we use the continuous flash paradigm to perform subconsciously on different facial expressions Experiment to study whether subjects have the same effect on abstract painting and facial expressions under consciousness. Through these several studies, we found that observers rated geometric abstract painting higher in terms of valence, while inverted geometric abstract painting scores were lower. In terms of arousal, observers rated geometric abstract paintings lower than expressing abstract paintings, inverted. Will not change the observer's arousal. At the same time, it was found that the subjects' breakthrough inhibition time for paintings types with higher emotional scores was faster, and abstract paintings and facial expressions had the same effect under consciousness. All in all, these findings indicate that abstract works have a strong objectivity to emotional cognition.

KEYWORDS: *Abstract art painting, continuous fliash suppression, facial expressions, emotional cognition*

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I. INTRODUCTION

People's appreciation of art paintings has a long history, and a broad consensus has been formed. However, the mechanism of art painting's conveying emotions has not been studied in depth. The previous research on emotional cognition of art paintings is mostly limited to the subjective feelings and feelings of observers. Research on neuroscience. We believe that the main factor limiting the success of many methods of neuroscience and emotional cognition is the lack of multi-method research. If we can use different methods and knowledge of different disciplines to participate in neuroscience and emotional cognition research, it will be exciting. Result[1]. At the same time, we found that the current research on the emotional cognition of art painting lacks data sets for the influence of multiple characteristics of art painting. We want to study the influence of multiple characteristics of art painting on the emotions of the observer, so the art painting we use is abstract art painting, because there are two kinds of paintings with obvious characteristics in abstract art painting, geometric abstract painting and expressionism abstract painting These two types of abstract painting features are obviously opposed to each other, and they have multiple different features. The influence of a single feature on emotional cognition is determined by balancing other features, so as to achieve the influence of a certain feature of artistic painting on emotional cognition[2]. We have developed a method to ensure the integration of scientific method and artistic theory as much as possible. An example of this multi-modal research is described below as three separate studies. In the first step, we selected 80 geometric abstract paintings and expressive abstract paintings in our MART image data set, and inverted these images to study geometric abstraction and expressive abstraction and their inversions on the observer's emotional score. In the second step, we use the CFS (continuous fash suppression) paradigm to study the emotional processing time of the four types of abstract paintings under consciousness. In the third step, we use the same method to study facial expressions to determine whether the observer has the same effect on abstract emotions and concrete emotions.

II. NEUROSCIENCE BASIC OF EMOTION

Which brain regions may constitute the emotional and aesthetic response to artworks? Under normal circumstances, certain areas of the limbic system will respond quickly to emotional stimuli, but the emotional cues of art will be more complex, involving cortical areas, such as the anterior cingulate cortex (ACC),

orbitofrontal cortex (OFC), insula and inferior frontal gyrus (IFG)[3].In the grouped data of a functional MRI study (Figure 1), participants can view paintings rated as highly emotional, as well as photos of emotional faces (happy or sad) and emotional scenes (funerals, banquets, patients in hospital beds, etc.). (A) The result of analyzing the areas where all three types of emotional stimuli are active, ranging from the visual area (the yellow and red areas on the far right) to the cognitive, motor, and emotional areas. (B) The right anterior cingulate is more active when viewing artworks with positive rather than negative emotions. (C) The right orbitofrontal cortex is more active for emotional judgments of artworks, but it is also very active when viewing faces and scenes. (D) In the lower frontal gyrus area of the brain, BOLD activity has the greatest impact on emotional abstract art images compared with faces or scenes[4].

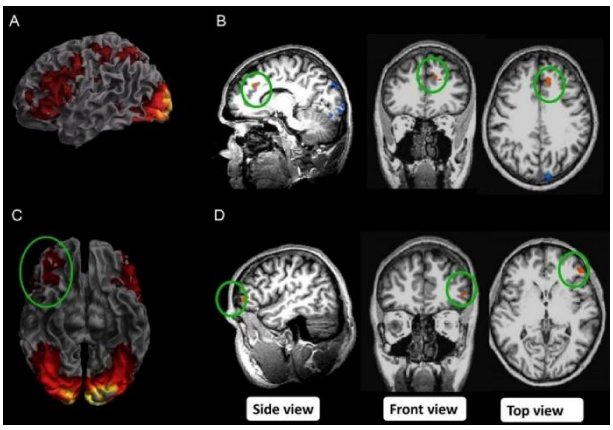

Figure 1

III. RESEARCH ON EVALUATION OF ABSTRACT PAINTING

Compared with the traditional emotional research, there are few emotional researches in art painting, and most of the emotional research in painting is limited to color, without considering the content of painting itself. We choose two art paintings with a large difference in appearance, geometrical abstract painting and expression abstract painting. These two types of abstract paintings have obvious differences in content. Geometric abstraction is generally brighter, with complementary color contrast and relative simplicity. And the regular form is identifiable (the first row in Figure 2); the expression abstract painting is generally dark, composed of chaotic colors and full of irregular marks, and it is difficult to identify the content (Figure 2, second row)[5]. After the painting image is inverted, it will obviously change the semantics of geometric abstract painting, but it will have little effect on the chaotic and difficult-to-recognizable expression abstraction. Therefore, in this experiment, we will not only study the difference between the subjects' emotional scoring between geometric abstraction and expression abstraction, Will also study and analyze the impact of the semantic features of painting on the subjects emotional cognition.This experiment is based on Russell's emotional model, allowing participants to evaluate valence and arousal[6]. There are 7 levels, 1 is the lowest and 7 is the highest.

Figure 2

Participant

A total of 16 subjects (11 males, 5 females, with an average age of 22) participated in the emotional scoring. The participants were all students from Yunnan University and had no brain diseases. All participants had normal or corrected vision. Participants No specific background or training in art or art history. All participants gave written informed consent before participating, and were paid after the experiment. All

participants gave written informed consent before participating, and the experimental procedure complied with the ethical guidelines of the Declaration of Helsinki.

Calculation

Based on the above experimental process, we obtained a total of 16 subjects' scoring data. After analyzing the experimental results, we obtained forward Geometric Abstraction(Geom), reversed Geometric Abstraction (Geom_reverse), forward Abstract Expressionism(Abex) and reversed Abstract Expressionism (Abex_reverse), Through the analysis of the data, we get the average of the scoring results of the four groups of paintings,As shown in Table 1. We can see that in the dimension of valence, the emotional score of geometric abstract painting is significantly higher than expression abstract painting. The score of forward painting in geometric abstract painting is higher than that of inversion, but there is no obvious gap in the expression abstract painting. In the arousal dimension, geometric abstract The score of is significantly lower than that of expression abstract painting, and the inversion of the image does not significantly change the observer's evaluation of arousal.

	Geom	Geom_reverse	Abex	Abex_reverse
Valence	4.70	3.86	2.25	2.30
Arousal	3.60	3.50	4.89	5.01

Table 1

Rating Consistency

In order to assess whether observers' ratings of paintings are consistent, we still use a two-way random effects intra-class correlation model (ICC) to analyze the ratings of each participant for each painting to test the consistency of each dimension separately. After our analysis, we found that geometric abstract painting has a higher consistency in the scoring of valence dimension, and forward geometric abstract(ICC=0.842, 95%ICC=0.768-0.900) higher than reversed geometric abstract paintings(ICC=0.771, 95%ICC=0.663-0.856); the score consistency of expression abstract paintings is significantly lower than that of geometric abstract paintings.The forward expression abstract paintings(ICC=0.641, 95%ICC=0.472-0.773) is higher than the reversed expression abstract paintings(ICC=0.609, 95%ICC=0.425-0.752). In terms of arousal dimension, forward geometric abstract paintings(ICC=0.739, 95%ICC=0.617-0.835) is higher than reversed geometric abstract paintings(ICC=0.702, 95%ICC=0.561-0.811); the forward expression abstract paintings(ICC=0.494, 95%ICC=0.256-0.680) also higher than the reversed expression abstract paintings(ICC=0.445, 95%ICC=0.183-0.648).

IV. RESEARCH ON ABSTRACT PAINTING IN CFS

In order to achieve the condition of subconscious visual cognition, the CFS (Continuous Flash Suppression) paradigm is needed. The CFS paradigm is obtained by improving the flicker suppression paradigm, which can effectively control the experimental paradigm. In a typical CFS paradigm, the range that the subject's two eyes can see is split, and one eye is presented with a series of richly contoured, high-contrast Mondrian masks at a stable rate, and the other shows a static low In contrast images, it was found that the subjects did not perceive the appearance of static low-contrast images throughout the observation period. This reflects the inhibitory effect of the CFS paradigm, which is its advantage[7].

Experimental Design

We use a color mask, and this experiment has 2*2 conditions (Geom, Geom_reverse, Abex, Abex_reverse). There are 4 blocks in total, and each block contains 80 trials, including 20 trials for each condition. The order of trials in each block is completely random, and each subject completes 320 trials. At the beginning of each trial, + is displayed randomly for 300~500ms, presented on both sides, used for image focusing, then the main eye side presents a 1500ms~2000ms random time masking image, and the non-dominant eye side of the experimental scene is gradually entered in 6s The display is fully presented at 6s, and the dynamic masking image on one side of the main eye does not disappear during the presentation. Finally, the dynamic masking image is presented on both sides for 500ms to eliminate the afterimage (Figure 3). All participants in this experiment are the same as the previous experiment[8].

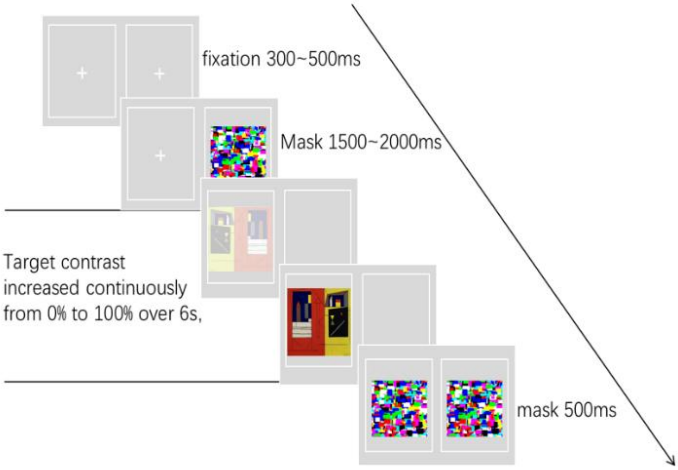

Figure 3

Calculation

In this experiment, we collected the time when the participant broke through the mask inhibition, which is the reaction time. We collected the average response time (ART (ms)) data of four groups of drawing images of 16 subjects, and excluded the extreme data other than 3 times the variance of the reaction time. After analyzing the remaining valid data, we obtained each group The average reaction time of the painted image (Table 2). Through the mean value, we can find that the average reaction time of geometric abstract paintings is lower than that of expressive abstract paintings. The reaction time of forward geometric abstraction is lower than that of reversed geometric abstraction; The reaction time of forward expressionist abstract paintings is no different from that of reversed expressionist abstraction.

	Geom	Geom_reverse	Abex	Abex_reverse
ART(ms)	2446	2635	2869	2882

Table 2

Significance Analysis

The response time data of the subjects under the four conditions obeys the normal distribution (Shapiro-Wilk test: $p>0.05$) and satisfies the hypothesis of homogeneity of variance (Levene test: $p>0.05$), so we use two factors of 2×2 Repeated measures analysis of variance (two-way repeated measures ANOVA) for testing[9]. As shown in Figure 4,the results showed that the main effect of abstract type is significant, geometric abstract paintings(M=2551, Std.Error=157.556) is significantly longer than the response time of expression abstract paintings(M=2876, Std.Error =194.134), $F(1,15)= 30.850$, $p<0.001$,$\eta_p^2=0.673$; the forward direction (M=2668, Std.Error =173.598) in the reversed relationship is slightly shorter than that of the reversed condition(M=2758, Std.Error =175.383). $F(1, 15) = 42.071$.$p<0.001$,$\eta_p^2=.737$. The interaction effect between the abstract type and the inverted relationship is significant, $F(1,15)=27.630$, $p<0.001$,$\eta_p^2=.648$. Further effect analysis found that under positive conditions, forward geometric abstract paintings(m=2466.375, Std.Error =152.424) is significantly faster than forward expression abstract paintings(M=2869.188, Std.Error =198.214), $F(1, 15)=36.068$, $P<0.001$,$\eta_p^2=0.706$; Under inverted conditions, it is found that geometric abstract paintings(M=2634.625, Std.Error=163.394) is faster than expression abstract paintings(M=2882.188, Std.Error=190.309),$F(1,15))=21.942$, $p<0.001$,$\eta_p^2=0.594$. Under geometric abstract painting conditions, the forward image(M=2466.375, Std.Error =152.424) reacts faster than the inverted image(M=2635, Std.Error =163.394), $F(1,15)=50.060$, $p<0.001$,$\eta_p^2 =0.769$. Under the condition of expression abstract paintings, it is found that there is no obvious difference in the reaction between the forward image(M=2869,Std.Error=198.214) and the inverted image(M=2882,Std.Error =190.309),$F(1,15)=0.060$, $p = 0.434$, $\eta_p^2 = 0.041$.

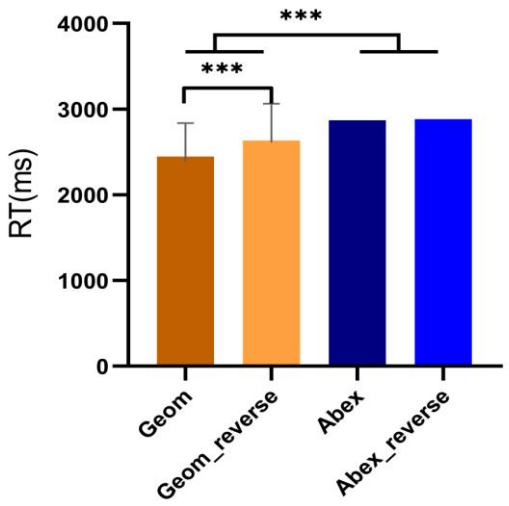

Figure 4

V. RESEARCH ON FACE EXPRESSION IN CFS

In order to study whether the subconscious emotional cognition of the abstract painting after inversion is universal, we inverted the emotional image of the face, studied the emotional cognition of the emotional image of the face, and used it to compare abstract paintings to explore people's emotions towards abstraction and specific emotions[10].

Materials and Methods

Here, we choose to use a dataset composed of Japanese and Caucasian facial expression images released by Humintell. This dataset contains a variety of facial expression images that have been classified[11]. We divide them into positive facial expressions and Negative facial expressions. For these facial expression images, because their color and brightness will affect the subject's response to breakthrough inhibition, we need to process these facial expression images before the experiment. Here we first intercept the faces and then perform grayscale on the images. Processing, after the grayscale processing, we equalize these images. Then we reverse these facial expressions, we will get four facial expressions.

The method used in this experiment is exactly the same as the previous experiment, and the experiment design is also the same.And the participants in this experiment are the same as the previous experiment.

Calculation

After obtaining the average response time of each subject to each group of images, we can calculate the average response time of each group of facial expression images (Average Response Time), as shown in Table 3, from the table it can be seen that there are differences in the reactions of the four groups of images. Generally speaking, the positive facial expressions are lower than the negative facial expressions, but the positive facial expressions after reversed are not higher than the negative facial expressions. For the inverted image, the positive facial expressions and negative facial expressions after reversed are longer than the positive facial expressions. We believe that for facial expressions with clear content, the content of the inverted facial expressions should be changed. Participants' reaction time to their breakthrough inhibition also became longer.

	Positive	Positive_reverse	Negative	Negative _reverse
ART(ms)	2127	2358	2344	2502

Table 3

Significance Analysis

After analysis, these four sets of data do not completely obey the normal distribution, so here we use Spearman test to analyze the significance[12].The significance is shown in Figure 5,forward positive facial (Mean=2172,Std.Deviation=346.450) and reverseded positive faces(Mean=2358, Std.Deviation=394.078) are significant on Spearman, and the p value is less than 0.001.forward negative faces(Mean=2344,Std.Deviation=352.446) and reversed negative faces(Mean=2502, Std.Deviation=410.529) are significant on Spearman, with p values less than 0.001. Positive faces(Mean=2265,Std.Deviation=377.004)

have a slightly shorter time for block breakthrough inhibition than negative faces(Mean=2422, Std.Deviation =384.734),and both are significant on Spearman,And the p value is less than 0.001.

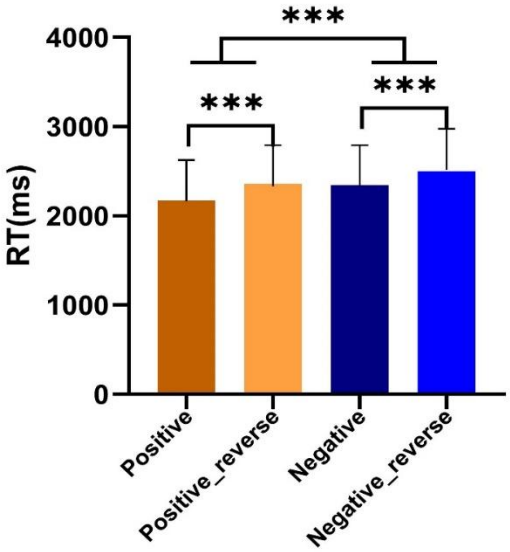

Figure 5

VI. CONCLUSION

This chapter uses the cfs paradigm to study the subconscious emotions of abstract art paintings and the subconscious emotions of facial expressions, and discover the principles of emotion recognition in abstract paintings by the subjects, which is the abstraction of the subjects expressing positive emotions Painting has a faster breakthrough inhibition time. This result is verified by our research on facial expressions. We found that the subjects' reactions to abstract painting and concrete facial expressions have the same trend. Changing the features of the painted image after inversion affects the subjects' recognizability of geometric abstract paintings. We also verified the facial expression images. We found that for recognizable images, the subjects were unconscious after inversion. The trend of their breakthrough inhibition time is also consistent.

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