Graphic Creative Design Based on Subconsciousness Theory

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ABSTRACT
In order to explore the role of the subconsciousness in creative graphic design and the physiological response mechanism of the brain in the creative inspiration emergence of the graphic design, this study explores the relationship between the subconsciousness and the creative graphic design. The study first gives an overview and definition of unconsciousness of the brain, and then reveals its role in the process of artistic creation with the posters of famous design masters as examples. In addition, in order to study the changes of EEG signals in creative graphic design, the contrast experiment is designed with urban image graphic creation as the example, and the changes in subconsciousness of the brain and the dynamics of EEG signals during the whole process from the fuzzy concept to the development of creative inspiration are recorded during the graphic design process. This paper research is helpful to guide the designer to face up to the brain subconscious impact in creative design, a more scientific cognitive brain subconscious relationship with graphic design, improve the use efficiency of creative thinking.

Key Words: Subconsciousness, Graphic Creativity, EEG Testing Technology, Creative Thinking

Introduction
Human design activities are closely related to psychological activities, thus design psychology research involves a comprehensive study of design, aesthetics, and psychology. The empirical study of design psychology begins with the psychological experiment and research on visual perception in the 20th century, the most important one of which is Gestalt psychological theory. Gestalt psychology focuses on the study of human perception of form, thus it is a psychology about “form”, and it is also called form psychology (Arnheim, 1998). Gestalt psychologists believe that people's psychological awareness activity is a priori “gestalt”, and people's graphic perception always appears in an image as a whole, a form that can show "a meaningful structure". In recent years, with the development of physiological measurement technology, EEG technology has provided a more scientific method to study the cognitive processing of human design process (Hu and Li, 2018).

Subconsciousness, which integrates psychology and brain science and is also the most difficult part to get hold of, has a subtle influence on psychological activities in the process of graphic creativity. Therefore, only through a thorough study of the relationship between subconsciousness of brain and graphic creativity can we gain a deeper understanding of the thinking activities and become active in the graphic design process, thus to express the design intention more effectively (Hoshiyama et al., 2003). There are two methods in the study of subconsciousness, which are behavioral analysis and EEG signal testing. Some scholars believe from the behavioral point of view that the brain subconsciousness signifies the sudden emergence
of the solution to a problem or understanding of an answer. In order to realize the accuracy in judging inspiration of brain subconsciousness, the accurate EEG signal testing technology and EEG signals are introduced (Rogers, 1985). There still lack practical cases and experimental analysis as how to carry out researches on graphic creative design based on subconsciousness theory (Rampil, 1998).

This study introduces the basic concepts of subconsciousness theory and graphic creativity, expounds the basic flow from the emergence of subconsciousness to graphic creative design output, and reveals the influence and role of brain subconsciousness in the process of artistic creation with the posters of famous design masters as examples (Geva and Kerem, 1998). Under the theoretician and technical support, a contrast experiment is designed, with the graphic creative design of the urban image of Bengbu city of China as the research material. A total 16 subjects are selected, a detailed experimental flow is designed and the experimental results are analyzed. The experiment, on the one hand, finds out the emergence point of inspiration with behavioral methods and on the other hand uses EEG techniques to dynamically detect the brain signals of the subjects, so that we can more scientifically understand the influence of subconsciousness on the creative graphic design and the cognitive mechanism of the brain.

Influence of Subconsciousness on Graphic Creativity

Proposal and definition of subconscious

Subconsciousness is the basic concept of psychoanalysis school founded by Freud, and psychoanalysis refers to a special method of using the latent impulse to explain psychological symptoms (Urquhart, 2001). Subconsciousness is a basic concept of psychoanalysis that is opposed to consciousness. The most obvious difference between the two is that consciousness can be clearly perceived, while the subconscious cannot be perceived, nor be expressed in words, and it is not subject to mental control, which is a unique high-level cognitive form of humans. The subconsciousness is composed of two parts: preconsciousness and unconsciousness, wherein the former may be transformed into consciousness, but it is almost impossible for the latter to be transformed to consciousness. The most common manifestation of subconsciousness is the guidance of people's consciousness by dreams (Freud, 2004).

Basic definition of graphic creativity

The term graphic derives from the Latin “graphicus” and the Greek “graphickos”, which mainly refers to the image created by means of painting, writing, engraving, and printing. Graphic creativity refers to the use of unique ideas and shapes to convert imagination and ideas into visualized graphics. In other words, graphic creativity is the use of visual arts to convert conceptual languages into graphical languages. Graphic creativity is to seek unique and novel graphic language based on creative thinking. It is one of the core elements of many design fields such as logos, advertisements, posters, illustrations, packaging, and multimedia design.

Influence of subconsciousness on graphic creative design

(1) Influence of subconsciousness on painting and graphic creativity

Sigmund Freud’s subconsciousness theory has a tremendous impact on the entire European and American modern art. The works of Surrealism School show such impact, and many artists of the School such as Rene Magritte and Salvador Dali have successfully converted human subconsciousness into visual images (Lin, 2015). As a master of surrealism with genius imagination, Dali’s works aim at pursuing subconsciousness, irrationality and fantasy, turning the dream into an objective painting. The Persistence of Memory, Dali’s oil painting created in 1931, is regarded as a surrealist classic, wherein the artist transforms the hard “watch” into “soft watch” to express the space and time in subconsciousness, and soft watch, crutch and crotch are the expressions of the subconscious language of the brain.

Similarly, the subconsciousness theory and the artistic expression techniques created by surrealism also have a profound effect on graphic creativity, which make countless designers to free themselves from traditional thinking for a visual world of imagination. For example, Hans Hillmann’s illustrations and posters have given full play to the surrealist expression methods, Guenther Kieser realizes the possibility of transforming surrealast painting into surrealast photography, and many posters of Gunter Rambow show the charm of the graphic design...
language, triggering more thoughts (Lin, 2015). In addition, designers such as Saul Bass and Cross James of the United States and Shigeo Fukuda of Japan also have also successfully applied the subconsciousness theory to a large number of poster graphic designs, using surrealist techniques to create a large number of classic works, which not only brings about visual creation, but also plays an important role in enlightening design thinking.

(2) Brain processing of graphic creative design
During the process of creative design, the brain is influenced by subconsciousness from the input of information to the output of creative design, and the basic flow of its graphic creativity is as shown in Figure 1. From the Figure, it can be seen that in the graphic creativity, first a fuzzy concept of the design is created under the influence of the subconsciousness, and then the design inspiration is produced through subconsciousness intervention, thus realizing the graphic creative design (Stephan et al., 2002).

Figure 1. Graphic creative design process

(3) Influence of subconsciousness on graphic creativity
Hans Hillmann is a well-known German poster designer, a pioneer and representative of European Visual Poetry and one of the world's most recognized visual art masters in the 20th century, whose poster design emphasizes the expression of graphic ideas, bold imagination, and ingenious conception. In particular, he often adopts surrealist expression techniques in movie posters to show his extraordinary creative ability in graphics, from which the traces of subconsciousness can be found (Lin, 2005).

As shown in Figure 2, it is a poster designed for the Japanese film Seven Samurai in 1963, whose major part is a killing and fighting scene of samurai, which is composed of different images created through entanglement, distortion, combination and association of shapes, turning graphics into an interesting visual game.

Figure 2. Movie posters of the seven samurai by Hans hillman

Figure 3 shows the poster designed for the movie Storm over Asia in 1961, wherein Hillmann uses the montage technique to create a strong sense of space and a strong black-and-white visual contrast by enhancing the contrast between the graphics of the cavalry and that of
the soldiers on galloping horses. There are many other similar graphic creations in other works of Hillmann, such as the graphic symbol of “a labyrinth wooden drawer” in the movie poster Der Prozess and the graphic of "oblique double-tower artillery" in the poster of Panzerkreuzer Potemkin. Hillmann's posters are influenced by surrealism, which provide examples for the liberation of creative thinking, demonstrating that subconsciousness, including fantasy and intuition, has an important influence on graphic creativity.

Experimental Study on Graphic Creativity Based on Brain Subconsciousness Theory

Experimental methods
(1) Purpose
Through theoretical analysis of subconsciousness and analysis of posters of designers such as Hans Hillmann, it can be seen that the subconsciousness plays an important role in the graphic creative design (Kaluinaite, 2004). In order to further explore the influence of the subconsciousness on the inspiration of graphic creativity, the dynamic monitoring of brain signal changes of the designers in the creative process are carried out through EEG testing technology to more accurately analyze its impact mechanism, so as to better guide designers to use the brain subconsciousness for creations (Sergeeva and Radosavljevic, 2009).

(2) Subjects
A total of 16 students majoring in visual communication design are selected, 8 in experimental group A which receive of subconscious hint, and the other 8 in control group B who do not receive any subconscious hint during the design process.

(3) Materials
Experimental materials include drawing tools and tools for EEG testing. Drawing tools include A4 drawing paper, pencils, color lead, gel pens, markers, erasers, etc., video recording equipment includes video camera, recording equipment, and tripod, and EEG equipment includes data receiving computer, EEG test cap, bench, etc.

(4) Content and process
The content of the experiment is graphic creative design centering on the representative urban buildings and cultural elements in Bengbu, China, with specific graphical creative topics such as Wanghuai Tower and flower drum. The subjects are required to use a variety of expression techniques to create graphic elements that can embody the city's features. Before the start of the experiment, the subjects are first informed that the EEG testing technology is harmless, so that they can participate in the graphic design in a relaxed and natural state. Firstly, the EEG of subjects in a 1-2 minute stationary state is collected to facilitate the later comparisons (Ahn and Yang, 2014; Ahn and Yang, 2014).

Assumptions on experimental results
In the design process, the brain receives repeated conscious and subconscious cognitive processing. The subconscious hint has impact on the emergence of creative thinking in graphic design, and the subconsciously produced creative inspiration can continuously push the design process forward (Hou et al., 2017). In the present study, it is believed that subconsciousness will have an impact on graphic creativity, and that, under the conditions with and without subconscious hint, there will be differences in EEG signals and EEG dynamic analysis between the experimental group and the control group,

Table 1. International Standard Lead 10-20 system map

<table>
<thead>
<tr>
<th>Location</th>
<th>Electrode name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forehead</td>
<td>Fp1, FP2</td>
</tr>
<tr>
<td>Parafrontalia</td>
<td>F7, F8</td>
</tr>
<tr>
<td>Frontal area</td>
<td>F3, F4, Fz</td>
</tr>
<tr>
<td>Central</td>
<td>C3, C4, Cz</td>
</tr>
<tr>
<td>Temporal lobe</td>
<td>T3, T4</td>
</tr>
<tr>
<td>Posterior temporal lobe</td>
<td>T5, T6</td>
</tr>
<tr>
<td>Parietal lobe</td>
<td>P3, P4, Pz</td>
</tr>
<tr>
<td>Occipit</td>
<td>O1, O2</td>
</tr>
<tr>
<td>Auricular</td>
<td>M1, M2</td>
</tr>
</tbody>
</table>

1) Collect static EEG data after the subjects' admission.
2) After the collection is completed, give the subjects of Group A the subconscious hint by showing them the PPTs with the works with subconscious styles by artists such as Salvador Dali and Rene Magritte.
3) Assign the design task and ask the subjects to draw the graphics.
4) At the end of the experiment, conduct the retrospective interviews to understand the changes in the thinking of the subjects during the design process.
and there will also be essential differences in the design manuscripts of the experimental group and the control group (Kaye, 2009).

**Experimental data collection**

(1) The manuscripts of the 16 subjects which are completed in a certain period of time are collected for comparative analysis.

(2) As shown in Tables 2 and 3, the number of creative inspirations of the experimental group and the control group during the design process is respectively counted, so are the time of occurrence and the number of effective inspirations.

<table>
<thead>
<tr>
<th>Test number</th>
<th>Design time</th>
<th>Inspiration</th>
<th>Effective Inspiration</th>
<th>Efficient%</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>20'27</td>
<td>12</td>
<td>10</td>
<td>83.33</td>
</tr>
<tr>
<td>A2</td>
<td>31'09</td>
<td>9</td>
<td>6</td>
<td>66.67</td>
</tr>
<tr>
<td>A3</td>
<td>12'10</td>
<td>8</td>
<td>6</td>
<td>75</td>
</tr>
<tr>
<td>A4</td>
<td>16'53</td>
<td>7</td>
<td>5</td>
<td>71.43</td>
</tr>
<tr>
<td>A5</td>
<td>11'48</td>
<td>7</td>
<td>5</td>
<td>71.43</td>
</tr>
<tr>
<td>A6</td>
<td>22'04</td>
<td>9</td>
<td>6</td>
<td>66.67</td>
</tr>
<tr>
<td>A7</td>
<td>07'50</td>
<td>3</td>
<td>2</td>
<td>66.6</td>
</tr>
<tr>
<td>A8</td>
<td>15'40</td>
<td>7</td>
<td>4</td>
<td>57.14</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>60</td>
<td>42</td>
<td>70%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Test number</th>
<th>Design time</th>
<th>Inspiration</th>
<th>Effective Inspiration</th>
<th>Efficient%</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td>13'39</td>
<td>6</td>
<td>4</td>
<td>66.67</td>
</tr>
<tr>
<td>B2</td>
<td>09'15</td>
<td>6</td>
<td>4</td>
<td>66.67</td>
</tr>
<tr>
<td>B3</td>
<td>10'13</td>
<td>5</td>
<td>3</td>
<td>60</td>
</tr>
<tr>
<td>B4</td>
<td>15'36</td>
<td>5</td>
<td>4</td>
<td>80</td>
</tr>
<tr>
<td>B5</td>
<td>17'00</td>
<td>7</td>
<td>4</td>
<td>57.14</td>
</tr>
<tr>
<td>B6</td>
<td>19'10</td>
<td>7</td>
<td>5</td>
<td>71.43</td>
</tr>
<tr>
<td>B7</td>
<td>11'27</td>
<td>5</td>
<td>3</td>
<td>60</td>
</tr>
<tr>
<td>B8</td>
<td>07'09</td>
<td>3</td>
<td>2</td>
<td>66.67</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>44</td>
<td>29</td>
<td>65.91%</td>
</tr>
</tbody>
</table>

**EEG Analysis of Graphic Creativity Experimental Results Based on Brain Subconsciousness Theory**

**EEG Analysis in creative process**

EEG signals are collected mainly in four stages, the resting stage, the thinking stage, the emergence of creative inspiration stage, and the later stage of creative inspiration, with the resting stage and the emergence of creative inspiration stage as the key research objects. EEG data are recorded at the electrode positions of Fp1, Fpz, Fp2, F7, F8, and T7. During the EEG signal acquisition process, attention shall be paid to the filtering process to remove ocular artifacts and muscle artifacts, and improvement of signal-to-noise ratio so as to preserve the authenticity of the original EEG signals.

**Energy spectrum analysis of EEG in graphic creativity**

The study conducts the statistical analysis of the energy spectrum of the 16 subjects at the Fp1, Fpz, Fp2, F7, F8, and T7 in the resting and emergence of creative inspiration stages. With the 6, 10, and 20 Hz as samples, the activity of the brain is marked, with the X-axis of the spectrum showing the frequency (Hz), and the Y-axis showing the energy Power (μV²/Hz).

Figure 4 shows the resting stage, from where it can be seen that the energy distribution of Fp2 is significantly higher than that of the other electrodes in the frequency range of 10-15Hz, while F8 has lowest energy distribution in the entire frequency cycle than other electrodes. It can be generally seen from the Figure that before the start of the graphic design task, the EEG signals of the subjects are in a normal state of thinking without fluctuations.

Figure 5 shows the stage of creative inspiration emergence, from where it can be seen that there is a significant difference in the energy spectrum between this stage and the resting stage. The peak value is up to $22\mu V^2/Hz$ in the design process during the whole stage, wherein the activation state of Fp2 and Fpz is significantly higher than other electrodes, and the activation of F8 is the most pronounced. It can be inferred that the creative inspiration is bursting and the brain is in the most active state during this stage.

Obvious differences can be seen in the EEG signals of subjects in the resting stage and the stage of creative inspiration emergence. The designer’s high-frequency oscillation in the frontal lobe decreases, and the degree of activation in the middle and high-frequency ranges tends to coincide with other regions. The prefrontal lobe is the brain region that completes the design cognitive processing.
Influence of subconscious hint of the brain on creative thinking process and results

The comparative analysis of the manuscripts of the experimental group A and that of the control group B show that the manuscripts of the control group B which do not receive any subconscious hint during the design process are subject to the shackles of the real image of Wanghuai Tower as shown in Figure 6, and the creative graphics are often more realistic, while the manuscripts of experimental group A which is hunted by the subconscious information, are full of changes and imagination as shown in Figure 7. In the retrospective interview at the end of the experiment, the subjects suggest that their creative process is affected by PPT shown to them before the beginning of the experiment, and the works of Dali, Rene Magritte and other masters in the PPT inspire them to diverge their thinking and seek associations, showing that subconsciousness has played a role in their creative process.

Through the analysis of EEG experimental data, it is shown that the experimental group shows a regular EEG signal increase at Fp1, Fpz, Fp2, F7, F8, and T7 during the resting-thinking-inspiration process, showing regularity in both time and amplitude, while a decreasing trend after the emergence of creative inspiration. Because there is no subconscious guidance in graphic creative thinking, the EEG signals of the control group show unstableness, and the amplitude changes of each electrode are different. The amplitude of some electrodes is weakened, and that of others decreases. The brain areas with the strongest response to inspiration of the group with subconscious hint are located in the prefrontal lobe and the lateral frontal lobe, but the active area of the brain of the group without subconscious hint is not obvious.

Figure 8 shows the EEG spectrum of the experimental group with subconscious hint, and Figure 9 shows the EEG spectrum of the control group without subconscious hint. Through the comparison of the two figures, it can be seen that the forehead of the group with subconscious hint is obviously activated, while the brain area of group without subconscious hint is not obviously activated in the process of graphic creative design, which is mainly distributed in left temporal lobe and the right frontal lobe.

Through the experiment using EEG testing technology based on subconsciousness theory, the function of subconsciousness in the process of graphic creativity is compared and analyzed, and the activities of various regions of the brain in the cycle of creative thinking and inspiration are objectively and scientifically observed. The results show that the brain is the most active during the stage of creative inspiration emergence, and that the experimental group, which accepts the subconscious hint, has more regular brain activity and higher creative design potentials.
Figure 9. EEG spectrogram at inspiration without subconscious hints

Conclusions
The creative inspiration in the graphic creative process has been considered to be vague and cannot be quantified. However, the development of EEG testing technology lays a foundation for further research on the relationship between creative inspiration and graphic creativity. This article explores the effects of brain subconsciousness on graphic creativity through EEG experiments. First of all, this study demonstrates the influence of the subconsciousness on graphic creativity with the posters of famous design masters as examples from the behavioral point of view and obtains the corresponding conclusions through comparative experiment. The major conclusions are as follows.

(1) Through the analysis of the subconsciousness in the creative process of graphic design and the analysis of posters by famous design masters, this study qualitatively explains the influence of the subconsciousness on graphic creative design.

(2) Through a detailed experimental flow, this study analyzes and compares the difference in EEG signal test between the group with subconscious hint and the one without, and quantitatively discusses the effective role of the subconsciousness on graphic creative design.

(3) This study will help guide the designers to recognize the role of subconsciousness on creative design, more scientifically understand the relationship between subconsciousness and graphic design, and then to use a variety of creative thinking to improve the performance of the graphic language.

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