

Exploring Artistic Differences: A Comparative Study of AI-Generated Images and Traditional Paintings

Yonghua Jiang, Luxi Feng, Ruijia Wang

School of Design and Art, Beijing Technology and Business University, Beijing, 102488, China

ABSTRACT

This research is conducted in the context of the rapid development of AI in the modern era. We aim to analyze the visual attention of participants towards AI-generated images and traditional painting works using eye tracking technology. Additionally, we will conduct a questionnaire survey to further explore and compare the artistic qualities of the two types of artworks. The ultimate goal is to determine whether AI-generated works can potentially replace traditional painting works.

KEYWORDS

AI-generated image; Traditional painting; Artistic difference; Comparative study; Eye movement tracking

1 Introduction

Technology is having a profound impact on human thought, knowledge, perception, and reality, as well as shaping the course of human history (Kissinger et al., 2022). Herb Simon, one of the pioneers of artificial intelligence in the 1950s, had his own perspectives on the principles of design thinking (Simon, 1969). Early research on the collaboration between technology, science, and art primarily focused on art history, anthropology, and ethnography (Orrghen, 2017). As modern society continues to digitize, art is gradually transitioning from physical spaces to virtual realms (Enhuber, 2015). In November 2022, Chat GPT developed by Open AI Lab completely revolutionized the field of artificial intelligence.

Since 2015, there has been a surge in the creation of 'artistic products' generated by artificial intelligence (AI). In 2019, which is considered the 'first year of the artificial intelligence era', AI officially entered the art field as a 'new tool' (Song, 2022). AI Art and Products encompass various forms such as machine learning-based generative art (Weiluch, 2021), deep learning-based mural art (Gaskins, 2021), and machine learning-based clothing (Yeung, 2021). At the Colorado State Exposition Art Competition in the United States, held in August 2022, the painting 'Space Opera House' generated by MidJourney won the first prize, bringing together images and discussions in the art field. The rise of AI in painting signifies its integration into the art field, capturing public attention through its remarkable visual expression and rapid generation methods (Bertão et al., 2023). AI is now extensively employed in numerous applications (Mueller and Massaron, 2021). Luo (2023) asserts that the metaverse, powered by computer vision, considers AI painting as a crucial element in its construction.

Huang et al. (2023) acknowledged the significance of AI technology in cultural creativity, particularly in the context of the AIGC. This area has become a prominent subject in current AI research. AI has the potential to revolutionize the way designers work, design content, and design reasons. The emotional connection between humans and artistic works is crucial, leading to ongoing debates on whether AIGC can achieve artistic excellence comparable to traditional painting. Eye tracking is a widely used method in psychological research to assess human viewing behavior (Kurzahls et al., 2016). To gain a deeper understanding of this matter, this article employs eye tracking technology and a questionnaire survey to analyze the artistic comparison between AIGC and traditional painting works. The aim is to explore the similarities and differences between the two forms of art. This study explores the artistic differences between AI generated images and traditional paintings by generating six different styles of paintings and one traditional painting. The research framework is shown in Figure 1.

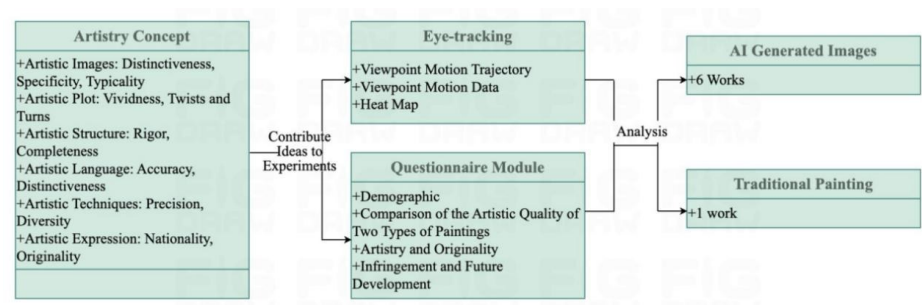


Figure 1 Research framework

2 Eye tracking technique

Carrasco (2011) proposed that vision captures approximately 80% of environmental information, making it the primary means of searching and receiving information. The first eye-tracking device was developed in 1962 by Mackworth and Thomas to record eye movement during unconstrained activities. In recent times, eye tracking technology has gained significant attention from scholars and designers due to its ability to accurately record human visual data and its advantages in quantitative analysis of human behavior and psychology (De la Fuente Suárez, 2020). According to Tian et al. (2023), eye tracking is considered a relatively accurate evaluation method and belongs to physiological measurement methods. Eye movement experiments have garnered significant attention in the fields of 'cognition emotion', usability, and aesthetics. Scholars have employed eye tracking technology for various purposes such as usability analysis, interface evaluation, interaction design, product prototype design, spatial experience design, and even metaverse design. They have also developed diverse design applications based on eye tracking research (Kang, 2017; Zhou et al., 2023). By analyzing eye movement data, we can gain insights into the focus, attention process, and cognitive style of the human eye during visual tasks. This analysis facilitates the examination of differences in visual attention between artificial intelligence painting and traditional painting.

3 Experimental method

The experiment involved participants observing both AI-generated and traditional paintings, while their eye movements were tracked using a Tobii X3-120 eye tracker. The participants were positioned 50-80 centimeters away from the computer screen to ensure accurate data collection. When participants view images, eye tracking devices are used to track the positions of their eyes both in and out of the image. This allows researchers to determine whether participants notice the focal part of the image and to analyze the path of eye movement between different components of the image (Kirtley, 2018). By comprehensively analyzing eye movement data and questionnaire feedback, we can evaluate participants' attention points and feelings when watching AI generated paintings, as well as their artistic differences compared to traditional paintings.

4 Experiment Process

Step 1, utilize the AI Art Generator App to create AI artwork using AIGC generation technology. Follow the given instructions in the following sequence "Create a portrait painting of a lady with a Mona Lisa like smile." "Create an oil painting of a woman's portrait with a mysterious smile." "Create an painting of a woman's portrait with a mysterious smile." "Generate six paintings with distinct styles that adhere to the instructions. The first painting differs from the other five AIGC paintings in that its instructions have "a Mona Lisa like smile", while the other five have a common theme of "a mysterious smile", generating works with different styles and techniques of expression. The generated painting styles are two "realistic", one "watercolor", "drawing", "oil painting", "Van Gogh", and the last one is the traditional painting "Mona Lisa", as shown in Figure 2.

Step 2, this study is based on 6 AIGC paintings and 1 oil painting of the Mona Lisa. We invited 24 participants to participate in eye tracking experiments at the end of May 2023. The experimental process is shown in Figure 3. Modern eye tracking devices typically include a camera or infrared sensor to capture eye movements. Unlike other eye tracking technology devices, during the experiment, participants do not need to install eye related devices on their heads. They only maintain the required fixed distance from the experimental display screen and observe the artwork within a fixed distance range to track the position of their eyeballs on the screen. When we observe artworks on the screen, the red dots inside the display screen will automatically move with our eyes and stay in the area we are looking at for a period of time. These movement and gaze behaviors can reflect our level of interest and attention to different visual stimuli. In this experiment, each artwork was observed for 10 seconds, and the sample size consisted of 24 subjects who had no symptoms of color blindness, color weakness, or other defects. We excluded any invalid eye movement data through data extraction and screening, resulting in a final analysis of 24 valid data points.

Step 3, after completing the experiment, fixation point data was collected from 24 participants for 7 artworks. Table 1 shows the eye movement data of the first experimenter viewing the first image for the first second, while Table 2 shows the eye movement data of the 24th experimenter viewing the seventh image for the first second.

Step 4, generate eye tracking heat map videos of 24 participants for 7 painting works, respectively, as shown in Figure 4. The redder the color of the hot spot area in the image, the longer the focus duration of the participants' eyes. It can be seen that in the first realistic style artwork, the focus of the participants' gaze is on the face, especially the right eyebrow and eye area, with a small number of participants' gaze on the character's neck area; The second realistic style artwork, with participants focusing on the eyebrow and eye positions of the characters, as well as partially focusing on hair, hands, and shoulders; The third watercolor style artwork, where participants focus their gaze on the eyebrow and eye regions, earrings, and a small amount of gaze on the character's face; The fourth drawing style artwork, where participants focus

their gaze on the character's face, especially the facial features, with some focusing on the character's hair; The fifth oil painting style artwork, in which participants' gaze is mainly focused on the five facial features of the characters, followed by their ears and clothing; The 6th Van Gogh style artwork, where participants focus their gaze on the head of the character, especially at the right eyebrow and eye area; The last traditional painting of the Mona Lisa, in which the participants' gaze is similar to that of the first six blessings, focuses mainly on the character's head, facial features, and eyebrows and eyes.

Based on our analysis of eye movement data, we have determined that there is no significant difference in people's visual attention and emotional connection between AIGC and traditional painting works. In fact, we found a high degree of similarity between them. Therefore, we can conclude that AIGC-generated painting works are able to effectively imitate traditional painting works.

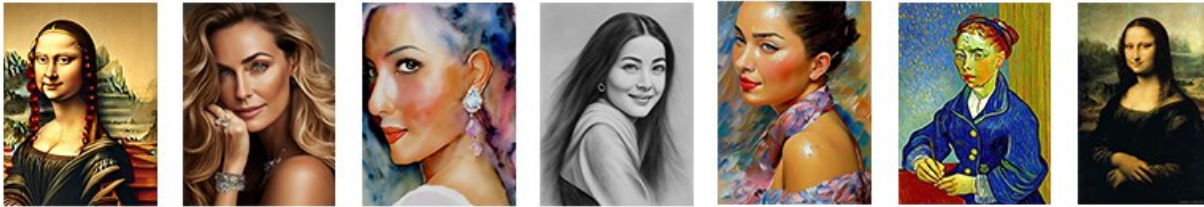


Figure 2 6 AIGC paintings and 1 oil paintings of the Mona Lisa

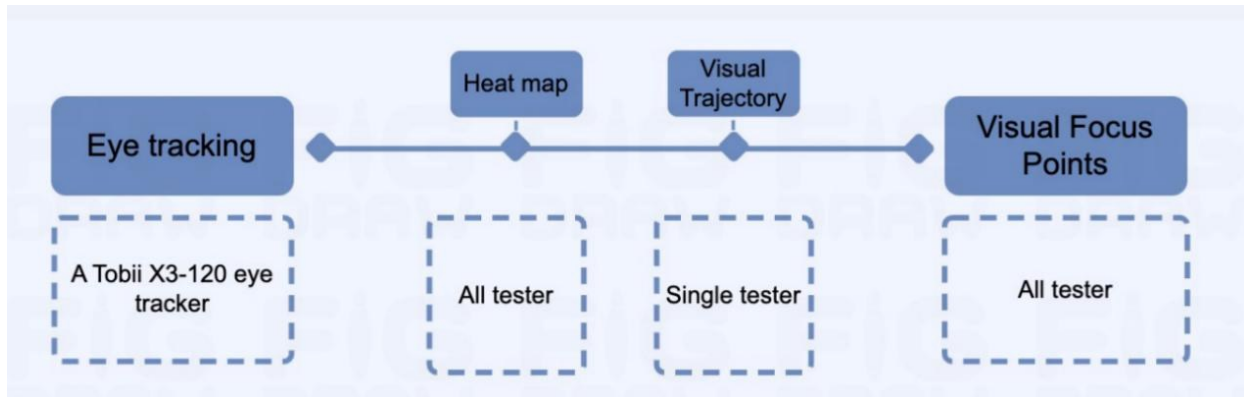


Figure 3 Experimental procedure

Table 1 The first experimenter viewed the eye movement data of the first image in the first second

▲ P	Q	R	S	TUVWXYZ	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AT	AU	AV	AW
261054	710	211	500	778			73959	15:51:30.007	6872332032												Unclassified		42
261055	710	211	500	778			73967	15:51:30.015	6872340366												Unclassified		42
261056	710	211	500	778			73975	15:51:30.023	6872348696												Unclassified		42
261057	710	211	500	778			73984	15:51:30.032	6872357029												Unclassified		42
261058	710	211	500	778			73992	15:51:30.040	6872365365												Unclassified		42
261059	710	211	500	778			74000	15:51:30.048	6872373705												871 Saccade		50
261060	710	211	500	778			74009	15:51:30.057	6872382025												871 Saccade		50
261061	710	211	500	778			74017	15:51:30.065	6872390376												871 Saccade		50
261062	710	211	500	778			74025	15:51:30.073	6872398690												871 Saccade		50
261063	710	211	500	778			74034	15:51:30.082	6872407037												871 Saccade		50
261064	710	211	500	778			74042	15:51:30.090	6872415360												871 Saccade		50
261065	710	211	500	778			74050	15:51:30.098	6872423689												Unclassified		17
261066	710	211	500	778			74059	15:51:30.107	6872432020												Unclassified		17
261067	710	211	500	778			74067	15:51:30.115	6872440357												872 Saccade		83
261068	710	211	500	778			74075	15:51:30.123	6872448698												872 Saccade		83
261069	710	211	500	778			74084	15:51:30.132	6872457029												872 Saccade		83
261070	710	211	500	778			74092	15:51:30.140	6872465366												872 Saccade		83
261071	710	211	500	778			74100	15:51:30.148	6872473685												872 Saccade		83
261072	710	211	500	778			74109	15:51:30.157	6872482028												872 Saccade		83
261073	710	211	500	778			74117	15:51:30.165	6872490364												872 Saccade		83
261074	710	211	500	778			74125	15:51:30.173	6872498693												872 Saccade		83
261075	710	211	500	778			74134	15:51:30.182	6872507024												872 Saccade		83
261076	710	211	500	778			74142	15:51:30.190	6872515351												872 Saccade		83
261077	710	211	500	778			74150	15:51:30.198	6872523690												Unclassified		8
261078	710	211	500	778			74159	15:51:30.207	6872532011												873 Saccade		67
261079	710	211	500	778			74167	15:51:30.215	6872540356												873 Saccade		67
261080	710	211	500	778			74175	15:51:30.223	6872548677												873 Saccade		67
261081	710	211	500	778			74184	15:51:30.232	6872557011												873 Saccade		67
261082	710	211	500	778			74192	15:51:30.240	6872565354												873 Saccade		67
261083	710	211	500	778			74200	15:51:30.248	6872573676												873 Saccade		67
261084	710	211	500	778			74209	15:51:30.257	6872582008												873 Saccade		67

Table 2 The 24th experimenter viewed the eye movement data of the 7th image in the first second

	A	P	Q	R	S	TUVWXYZ	AB	AC	AD	EFGHIJKLMNQRST	AT	AU	AV	AW
261054	710	211		500	778		73959 15:51:30.007		6872332032				Unclassified	42
261055	710	211		500	778		73967 15:51:30.015		6872340366				Unclassified	42
261056	710	211		500	778		73975 15:51:30.023		6872348696				Unclassified	42
261057	710	211		500	778		73984 15:51:30.032		6872357029				Unclassified	42
261058	710	211		500	778		73992 15:51:30.040		6872365365				Unclassified	42
261059	710	211		500	778		74000 15:51:30.048		6872373705			871 Saccade		50
261060	710	211		500	778		74009 15:51:30.057		6872382025			871 Saccade		50
261061	710	211		500	778		74017 15:51:30.065		6872390376			871 Saccade		50
261062	710	211		500	778		74025 15:51:30.073		6872398690			871 Saccade		50
261063	710	211		500	778		74034 15:51:30.082		6872407037			871 Saccade		50
261064	710	211		500	778		74042 15:51:30.090		6872415360			871 Saccade		50
261065	710	211		500	778		74050 15:51:30.098		6872423689			Unclassified		17
261066	710	211		500	778		74059 15:51:30.107		6872432020			Unclassified		17
261067	710	211		500	778		74067 15:51:30.115		6872440357			872 Saccade		83
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261075	710	211		500	778		74134 15:51:30.182		6872507024			872 Saccade		83
261076	710	211		500	778		74142 15:51:30.190		6872515351			872 Saccade		83
261077	710	211		500	778		74150 15:51:30.198		6872523690			Unclassified	8	
261078	710	211		500	778		74159 15:51:30.207		6872532011			873 Saccade		67
261079	710	211		500	778		74167 15:51:30.215		6872540356			873 Saccade		67
261080	710	211		500	778		74175 15:51:30.223		6872548677			873 Saccade		67
261081	710	211		500	778		74184 15:51:30.232		6872557011			873 Saccade		67
261082	710	211		500	778		74192 15:51:30.240		6872565354			873 Saccade		67
261083	710	211		500	778		74200 15:51:30.248		6872573676			873 Saccade		67
261084	710	211		500	778		74209 15:51:30.257		6872582008			873 Saccade		67

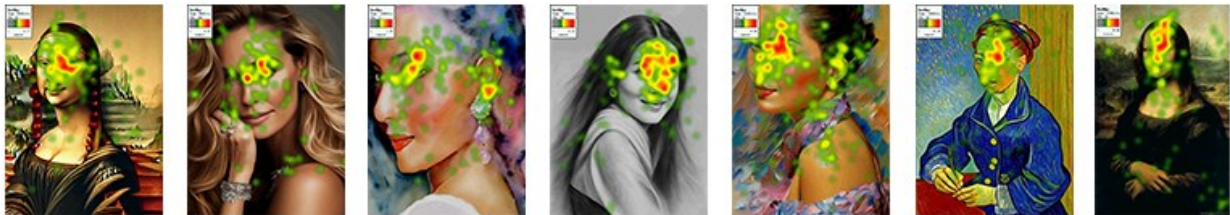


Figure 4 Results of eye movement tracking heat map for 7 painting works

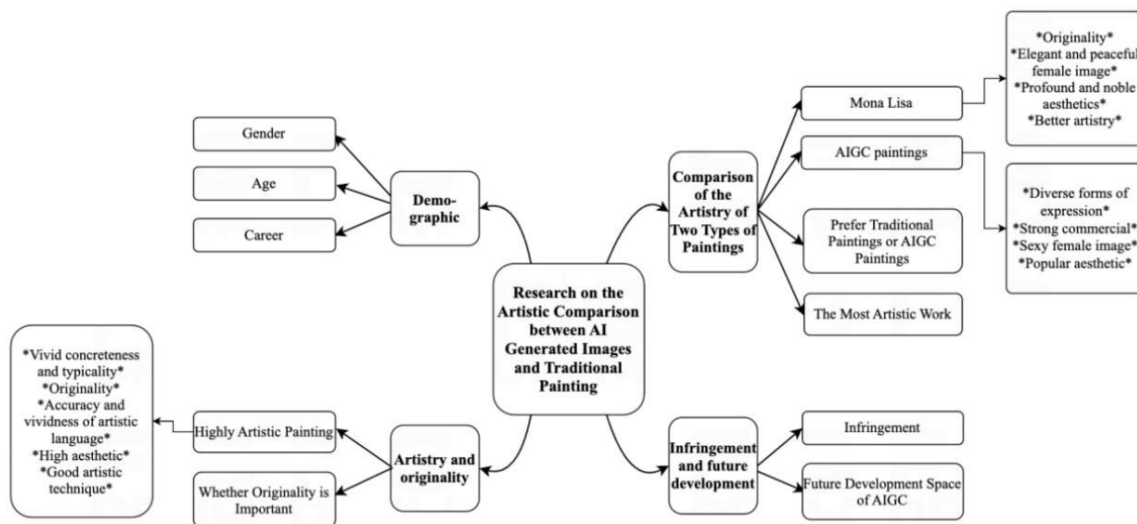


Figure 5 Questionnaire investigation

Step 5, To deeply analyze people's subjective artistic evaluation of AIGC and traditional painting works, an experimental study conducted an online survey questionnaire from early to mid June 2023, as shown in Figure 5. The survey consisted of 22 questions comparing the artistic quality of AIGC and traditional painting works. These questions included 16 single choice questions and 6 multiple choice questions. A total of 234 valid questionnaires were collected, with 125 female and 109 male participants, including those who had previously completed eye movement experiments. The majority of participants (49.15%) were aged 21-30, followed by 40.17% aged 31-40. Participants under 20 years old and over 40 accounted for 10.69% of the total. The questionnaire research revealed that when appreciating a figure

painting, people primarily focus on the five facial features of the character, followed by the head and body.

Through data analysis of questionnaire survey results, it was found that a larger proportion of participants believe that traditional painting works are more original, artistic, and aesthetically pleasing. They perceive traditional paintings to have better clarity and typicality of artistic images, accuracy and distinctiveness of artistic language, better artistic techniques, and better artistic expression. Additionally, traditional paintings are seen to reflect the degree of beautiful expression in social life and effectively convey thoughts and emotions. When asked about the most artistic work among the seven, 36.75% of participants chose the seventh traditional painting, making it the most frequently selected work. Painting 4 and 5 were considered the most artistic by 14.53% of participants, while 11.97% believed painting 3 to be the most artistic. Painting 2 received 9.4% of the votes for being the most artistic, and painting 6 received 8.12%. The least number of participants, only 4.7%, selected painting 1 as the most artistic. In summary, traditional paintings are widely regarded as the most artistic, with painting 6 being particularly appreciated and enjoyed, as depicted in Table 3.

Compared with AIGC generative art works, more than half of the participants believe that the traditional painting works of "Mona Lisa" have originality, express elegant and peaceful female images, have profound and noble aesthetics, and have better artistry. At the same time, 38.89% of participants believe that it reflects diverse forms of expression. On the contrary, compared to the traditional painting of the 7th Mona Lisa, among the common features shared by the first 6 AIGC paintings, 50% of participants believe that they have diverse forms of expression, about 40% of participants believe that AIGC art works have strong commercial value, express sexy female images, and are characterized by popular aesthetics, and 23.93% of participants believe that AIGC art works have originality. Only 13.25% of people believe that AIGC artworks have better artistic quality. In contrast, more participants believe that traditional painting works are more original and artistic. Correspondingly, among these 7 works, 30.34% of participants chose painting 7, 19.23% chose painting 4, and nearly 12% chose 2, 3, 5, and 6, respectively. Only 2.99% of participants chose 1. It can be seen that when choosing individual art works, more people appreciate and enjoy traditional painting works. When asked whether participants prefer traditional paintings or AIGC paintings, 48.29% of people chose traditional paintings, 11.54% chose AIGC paintings, and 38.46% chose both. Therefore, we can see that the art works generated by AIGC are also worth appreciating and liking, but more people still appreciate and like traditional paintings more. But why is the traditional painting in painting 7 often superior in terms of single item selection compared to the first six works? Our questionnaire raised the question: What elements do painting works need to possess in order to be a highly artistic painting? This is a multiple-choice question with 7 options given to participants in the questionnaire, as shown in Table 4. The highest number of participants chose artistic images with good specificity, typicality, and originality, with 66.24% and 60.26% respectively. 59.4% of participants chose artistic language with good accuracy and distinctiveness, 57.26% of participants chose aesthetics, 53.42% chose artistic techniques, and 45.3% of participants believed that artistic performance was good, 38.03% of participants believe that it should reflect the beauty reflected in social life and the expression of thoughts and emotions. Regarding the issue of whether originality is important for a highly artistic painting, 49.15% of participants believe that originality is very important, 47.01% believe it is important, and only 3.85% of participants believe that originality is not very important. The number of participants who choose to completely ignore originality is 0. Regarding the issue of whether AIGC painting works infringe upon the original works referred to, 37.61% of participants believe it is, 31.62% of participants believe it is not, and the remaining 30.77% of participants are unclear. Finally, regarding whether AIGC painting works have broader development space in the future, the vast majority of participants believe that they have broader development space, accounting for 80.34% of the total number. Only 6.84% of participants believe that they do not, while the remaining 12.82% of participants express uncertainty.

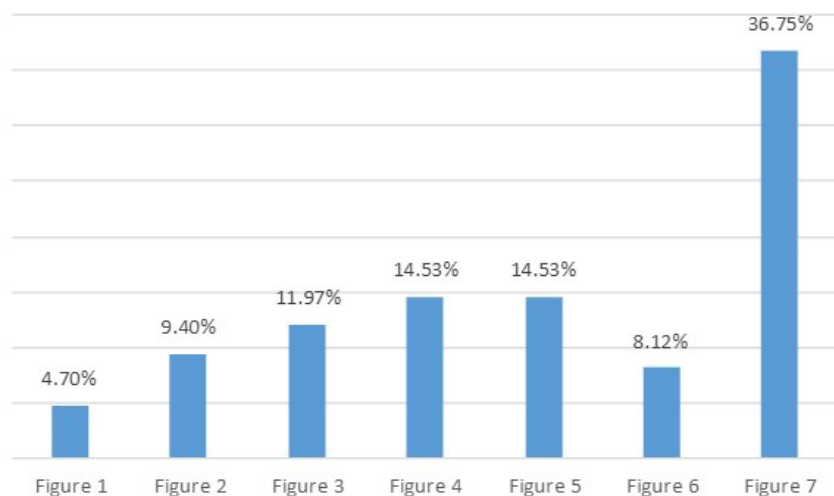


Figure 6 Which of these 7 works do you think is the most artistic?

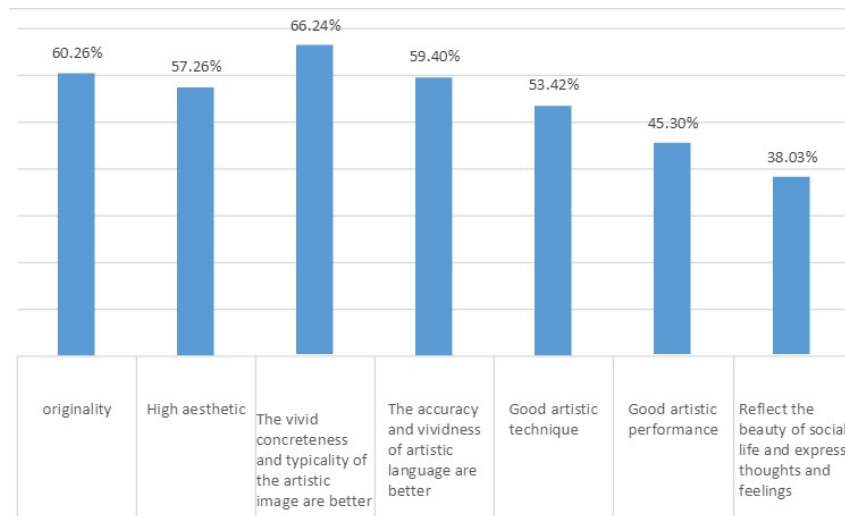


Figure 7 Which of the following elements do you think a painting work needs to possess in order to be highly artistic?

5 Result comparison

Firstly, based on the analysis of eye movement data, we found that there are similarities in people's visual attention between AIGC paintings and traditional paintings, with the focus on the five senses, head, and body of the characters; However, through the analysis of survey data, it was found that there are significant differences in people's emotional connections between AIGC paintings and traditional paintings. Traditional paintings usually attract more attention from participants because their originality, aesthetics, and artistry are higher than those of AIGC paintings. This allows people to feel the author's emotions towards the work and the current social life reflected in the work. Moreover, traditional paintings pay more attention to details and can better resonate with participants' emotions. Secondly, there is controversy over whether AIGC paintings have originality, and the vast majority of people believe that originality is one of the important factors that make a painting highly artistic. Anyone engaged in artistic creation needs to continuously strengthen their own originality research in creative learning, and actively demonstrate it in the creation of works. This is a prerequisite for achieving high artistic quality in artistic works. Aesthetics is the essential attribute that distinguishes art from all other non artworks. The emergence of art is to meet people's aesthetic needs and achieve spiritual pleasure and satisfaction. Therefore, having aesthetics is also one of the necessary factors for a work of art to have a high artistic value. In addition, the current social life and cultural connotations reflected in traditional painting works cannot be replaced by AIGC painting works. Traditional art works often contain the current spirit of the times, reflecting the spirit of their respective times and reflecting contemporary society. Art works can use the most direct image to record various events that occur in contemporary society and reflect the inner desires of people in each era, Social life is the only source of artistic creation, and artists' works of art are the vivid forms of social life. It can be seen that traditional art works often come with the subjective consciousness of creators, which is the materialization of their thoughts and a microcosm of the current social state when art works appear. These are all things that AIGC art works cannot possess.

However, AIGC artwork still has its advantages. Firstly, it can quickly draw paintings that meet the requirements according to human instructions, with lower time costs and the final image performance similar to traditional painting works, almost fully meeting the requirements of the instructions. Secondly, AIGC artworks have diverse forms of artistic expression, with diverse artistic techniques. The final presentation of artworks is also diverse and vivid, and the techniques that traditional painting can express can be imitated by AIGC artworks. Many people believe that AIGC artworks also have aesthetic, original, and artistic qualities, but their artistry is far lower than traditional painting works. For the future development of AIGC technology in human society, most people believe that it has a broader development space in the future, which brings greater possibilities to various fields. At the same time, it will also provide useful references for the integration of art creation and artificial intelligence technology in the future. From the perspective of artistic research, although AIGC paintings have brought new possibilities in the field of art, the artistic quality of traditional paintings is much higher than that of AIGC paintings, and the unique style and emotional expression of paintings cannot be replaced by AIGC paintings.

6 Conclusion and discussion

This study utilized eye tracking technology and questionnaire surveys to compare the artistry of AIGC with traditional painting works. By conducting a comprehensive analysis of the differences between the two, this study aims to provide valuable insights for the integration of future artistic creation and artificial intelligence technology. However, the study

ultimately concludes that traditional paintings exhibit greater artistic value, aesthetic appeal, and originality compared to AIGC paintings. While AIGC paintings have introduced new possibilities in the art field, they are still unable to replicate the unique artistic style and emotional expression that traditional paintings possess.

According to expert Kai-Fu Lee, artificial intelligence (AI) has the potential to be a highly transformative technology in human history. There is substantial evidence to suggest that research in the field of aesthetics will continue to focus on the originality and aesthetic value of works generated by AIGC technology. These studies will offer valuable support to humans in utilizing artificial intelligence technology to streamline monotonous tasks and enhance the quality of life in the future.

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