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A quantitative study of stylistic differences between Giacometti and his contemporaries based on big data modeling

Jing Ma[1,✉]

[1] *College of Child Education and Development, Hangzhou Campus, Zhejiang Normal University, Hangzhou, Zhejiang, 321000, China*

ABSTRACT

Based on the view that artistic style is mainly reflected in sculpture and painting, the sculpture and painting style of Giacometti is analyzed in depth. Starting from the scope of application of big data technology, the theoretical knowledge based on information theory is proposed to explore the differences in the styles of Giacometti and his contemporaries, and the basic concepts used in the processing are defined, including Shannon entropy, conditional entropy, and interactive information. Redundancy, orderliness, and complexity are set as eigenvalues that can characterize the style of art works, and the eigenvalues of the style of Giacometti and contemporaneous artists are analyzed. The minimum, maximum, and average values of the complexity of Picasso's works are 207, 991, and 596, respectively, while the values of the three indexes of the complexity of Giacometti's art works are 446, 990, and 718, respectively, and on the whole, the complexity of Picasso's works is smaller than that of Giacometti's works. This paper comprehensively reveals the stylistic differences between Giacometti and his contemporaries through the analysis of quantitative characteristic indexes.

Keywords: Shannon entropy, redundancy, orderliness, complexity, Giacometti

1. Introduction

Alberto Giacometti was a famous sculptor, oil painter, sketcher and poet. Born in Bonneau, Switzerland, on October 10, 1901, and died in Kure on January 11, 1966, Alberto Giacometti lived in Paris, France, and his works included drawings and paintings, with his sculptures being the most influential [1-4]. In the early 1930s, his early sculpture style was mainly surrealism, and after 1935, the subject matter of his sculpture changed to mainly figures, adding his own unique style to realism, becoming one of the most important sculptors in Paris after World War II, and his influence continues to this day [5-8].

✉ Corresponding author.
E-mail address: MJZJHZ197765@126.com (J. Ma).
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Compared with the style of his contemporaries, the sculptures created by Giacometti have different characteristics. Firstly, under the influence of many factors such as the outbreak of the Second World War, which led to Giacometti's psychological loneliness and panic, and even some distortion of his heart, he created matchstick-like figures as thin as bean sprouts to symbolize the people who were charred by the war, in order to reveal the evils of the war, with the ultimate goal of driving away death [9-12]. Secondly, Giacometti was influenced by Rodin's hyper-realistic sculpture of the human body and his hallucination and stimulation of his surroundings, and his creations reflected figures that were closer to what one would see if observing them from a distance [13-14]. Giacometti's works during the war became smaller and smaller, even to a few centimeters, and in Sartre's words: these distinctive figures, so small that they could fit in a matchbox, occupy space and embody distance [15-16].

Through the description of Giacometti's artistic style, this paper summarizes the view that Giacometti's artistic style is mainly embodied in his sculptures and paintings. Standing on the perspective of big data model application, it formulates a quantitative research program based on information theory theoretical knowledge of the style of Giacometti and his contemporaries to conduct a quantitative research program, which first defines and outlines the Shannon entropy, conditional entropy, and interactive information, and provides a theoretical basis for the quantitative feature extraction of artistic style. A classical art website is selected as the main data source of this study, and the images of Giacometti's works and Picasso's works are the same as 50, so as to quantitatively explore the differences between the styles of Giacometti and contemporaneous artists in terms of redundancy, order, and complexity.

2. Quantitative study of Giacometti's artistic style

2.1. Giacometti's Artistic Style

Giacometti's artistic style is mainly reflected in his sculptures and paintings, with distinctive personal characteristics and profound ideological connotations.

2.1.1. Sculptural style. In the decade after 1935, he desperately wanted to find a path of his own. His post-World War II works reflect his thoughts on war and man himself. His sculptures of figures are closer to the impression of human beings when viewed from a distance, lacking in detail, and presenting a sense of surfaces that have been eroded and flaked off and are about to disappear into the dust. Giacometti himself called such sculptures “fat trimmed from space”. His works are different from Picasso of the same period, whose works show an eclectic tendency and whose sculptures are full of rounded forms, reflecting an aesthetic characteristic full of visual tension. The different styles of works stem from their own different artistic explorations, different life experiences and feelings towards forms.

2.1.2. Painting styles. Giacometti completes his work with an immersive perspective, as if the painter himself is also in the picture, having a certain communication with the characters in the painting, and when the viewer is watching his work, he is also in an immersive position to watch and think about it, as if he and Giacometti are watching and thinking about the real scene in front of him. Although most of Giacometti's images have only a single gray tone and linear shaping, they better highlight Giacometti's perceptual expression and emotional atmosphere, and the seemingly ambiguous and uncertain space triggers the viewer's thoughts. After breaking away from the surrealist school of painting, it can be seen from his paintings that Giacometti no longer obsesses over whether the expression of the picture technique is clear and concise, whether the picture presented is in line with the norm, and whether the language of painting has a sense of form and aesthetics. He abandoned the common painting techniques and ways of expression, and began to use a single linear composition, and the line has become an important use of his painting expression.

2.2. Quantitative Analysis Theory of Artistic Style

Information theory is a science that uses mathematical and statistical methods to study the laws of measurement, transmission and transformation of information. It has laid down contributions in a number of subject areas such as communication technology, physical disciplines, computer science, statistics, biology, image processing, etc. This paper presents a quantitative study of the style of Giacometti and his contemporaries based on theoretical knowledge of information theory. Before analyzing the digital artworks, the basic concepts used in the processing are introduced.

2.2.1. Shannon entropy. Entropy is a function of the probability of a thermal state of matter, while mathematically entropy represents the uncertainty of a state or problem under study. In information theory, entropy is used as a measure of uncertainty in a system. For a random variable, before conducting a random experiment, we can only know its probability distribution, and only after conducting the experiment can we get the exact value of the variable. At this point, through the experiment we eliminate the uncertainty and thus obtain information. The amount of information we obtain from this is equal to the entropy of the random variable.

Shannon not only defined the concept of information, but also gave a formula for calculating the entropy of information [17].

For an event the uncertainty of its occurrence is related to the probability of each state in which the event may occur. Generally speaking, the smaller the probability of an event, the greater its uncertainty, and the more difficult it is to guess whether it will happen or not. On the other hand, if an event has a higher probability of occurring, then the corresponding uncertainty is smaller. If the probability of an event is equal to 1, then it is a necessary event and its uncertainty does not exist. So, the amount of information it contains about a particular event is actually expressed in the form of an a priori probability function of its occurrence.

For a given event or variable, all the states in which it may occur form a set, which we call the sample space. Each of the available options then corresponds to an element in that sample space. For a set of discrete variables, the probability measure is the non-negative probability that an event will occur for each alternative. So for all possible events, the sum of their probabilities should be equal to 1. Assuming that this variable is discrete, its sample space can be expressed as:

$$x = \left[x_1, x_2, \cdots, x_n\right] \tag{1}$$

For any of these elements it occurs with probability:

$$p\left(x_i\right) = p_i \tag{2}$$

$$0 \le p_i \le 1 \tag{3}$$

$$\sum_{i=1}^{n} p_i = 1 \tag{4}$$

The concept of self-information is defined in information theory as the amount of information contained in a given message from a given source, which is commonly referred to as the amount of uncertainty reduction, denoted by $I\left(x_i\right)$:

$$I\left(x_i\right) = \log \frac{1}{p\left(x_i\right)} = -\log p\left(x_i\right) \tag{5}$$

$I\left(x_i\right)$ is the self-information of event x_i, which represents the amount of information contained in the event.

Since self-information is a random variable, an event is meaningless from an information-theoretic point of view if it occurs frequently or is well known. The smaller the probability of an event occurring, the more information it can give us after it occurs. For a discrete random variable, the mathematical expectation of the self-information of all possible states of the variable gives us the average amount of information, which is often called the Shannon entropy or the information entropy.

Shannon entropy is a measure of information built on a probabilistic statistical model, i.e., let a discrete random variable and its probability distribution be:

$$\begin{bmatrix} x \\ p \end{bmatrix} = \begin{bmatrix} x_1 & x_2 & \cdots & x_{n-1} & x_n \\ p_1 & p_2 & \cdots & p_{n-1} & p_n \end{bmatrix} \tag{6}$$

The values can be expressed as follows:

$$H = -\sum_{i=1}^{n} p_i \log_c p_i \tag{7}$$

p_i when the probability density function, $0 \le p_i \le 1$, $\sum_{i=1}^{n} p_i = 1$. The base c determines the unit of entropy, commonly used base by 2, the natural logarithm e and 10, the selected base of different Shannon entropy unit is different. In the research work of this paper, e is chosen as the base, at this time the corresponding Shannon entropy unit is nat.

2.2.2. Conditional entropy. The conditional entropy algorithm considers the sequential relationship between time series samples rather than the entropy value itself. It effectively characterizes the diversity of the subsequent succession of a given sequential pattern, and therefore can effectively measure the irregularity of the signal, with good resistance to noise and interference, and its specific process is as follows:

1) Given a time series as:

$$(x_i)_i = 1^N = (x_1, x_2, \cdots, x_i, \cdots, x_N) \tag{8}$$

2) Calculate the probability of an ordinal pattern pair as:

$$\begin{aligned} p_j &= \frac{\{i \in I \mid \Lambda \text{ There is an ordinal pattern } j\}}{N - d\tau - \tau} \\ q_{j,l} &= \frac{\{i \in I \mid \Lambda \text{ There is an ordinal pattern } j, \Theta \text{ There is an ordinal pattern } l\}}{\{i \in I \mid \Lambda \text{ There is an ordinal pattern } j\}} \end{aligned} \tag{9}$$

where mode l appears after mode j and has:

$$\begin{aligned} I &= \{d\tau + 1, d\tau + 2, \cdots, N - \tau\} \\ \Lambda &= (x_i, x_{i-\tau}, \cdots, x_{i-d\tau}) \\ \Theta &= (x_{i+\tau}, x_i, \cdots, x_{i-(d-1)\tau}) \end{aligned} \tag{10}$$

3) Calculate the corresponding conditional entropy as:

$$H(d, \tau, (x_i)_{i=1}^{N}) = -\sum_{j=0}^{(d+1)!-1(d+1)!-1} p_j q_{j,l} \ln(p_j q_{j,l}) + \sum_{j=0}^{(d+1)!-1} p_j \ln(p_j) \tag{11}$$

The negative logarithm of the probability indicates the amount of information carried by the possible events, and by multiplying the possible information with the probability of occurrence and then summing it overall, equation (12) can be reduced to the following form:

$$H(d, \tau, (x_i)_{i=1}^{N}) = -\sum_{j=0}^{(d+1)!-1} \sum_{l=0}^{(d+1)!-1} p_j q_{j,l} \ln q_{j,l} \tag{12}$$

Low conditional entropy estimates the complexity of the system because not all sequential patterns can occur within a time series of finite length. The relationship between time series length and order is satisfied:

$$(d+1)(d+1)! < N \tag{13}$$

2.2.3. Interactive information. Interaction information has a wide range of applications in feature selection in machine learning, medical imaging, statistical mechanics, cosmology, and art. In many applications, maximizing interaction information improves affiliation, which is often equivalent to minimizing conditional entropy. In the context of big data modeling, interaction information is often used as a criterion for feature selection. It can be used to characterize the correlation and redundancy between samples, and can be used to select features that are discriminative and not redundant with each other. Interaction information can also be used to determine the similarity between two different clusters in a data set. The application of interactive information is extremely wide, in addition to the above list of several different fields, there are many other fields are involved in interactive information, will not be introduced one by one, and this paper mainly explores the application of interactive information theory in the quantitative study of the differences between the styles of Giacometti and his contemporaries.

Interactive information between random variables X and Y is defined as:

$$I(X,Y)=H(X)-H(X\mid Y)=H(X)-H(Y\mid X) \tag{14}$$

It is the reduction of the uncertainty of X given the information of Y, that is to say the same amount of information between X and Y.

In image processing, the value of a pixel point in an image can be understood as a discrete random variable, and then the information theoretic approach can be used to quantify the stylistic differences between Giacometti and his contemporaries.

2.3. Artistic style quantitative feature extraction

For a color image I with N pixel point, for which the color is stored in 24 bit, then each pixel point corresponds to a color value in RGB the color space, and if we consider the color taken by each pixel point as a random variable $XRGB$ and all the color values in the color space as its sample space, then the sample space of this random variable X_{RGB} contains $1{,}28^3$ elements, that is, $1{,}28^3$ color values. In addition to the color space, this paper also applies to the luminance space X_L of the image, which corresponds to the luminance information of the image and satisfies $X_L=[0,128]$. The probability distributions of the random variables X_{RGB} and X_L can be obtained by using the histogram statistics method, and the maximum Shannon entropy $H_{\max}$ of these two random variables are 32 and 16, respectively.

2.3.1. Color palette redundancy. Palette redundancy is the reduction of palette uncertainty in an image. Any painting is composed of a wide variety of colors, so in every image there is uncertainty in its palette, and the amount of this uncertainty can be represented by the palette Shannon entropy $H(G_{RGB})$. If an image uses fewer kinds of colors, then its uncertainty is less and the redundant information is more, that is, the palette Shannon entropy is smaller and the redundancy is higher [18]. When artists create art works, according to their own painting needs or personal habits will determine the type of color needed for this painting, then the uncertainty of the color palette will be reduced. According to the concept of physical entropy, this creative process of the artist can be called the reduction process of the Shannon entropy of the palette, and the redundancy M_B of the palette is used to characterize the reduction of uncertainty of this palette, which is expressed by the following formula:

$$M_B = \frac{H_{\max} - H(X_{RGB})}{H_{\max}} \tag{15}$$

where $H_{\max}$ denotes maximum entropy, which means that all pixel points in the image have different color values, which is when the palette has the greatest uncertainty.

2.3.2. Shannon's entropy ordering degree. After proposing the Shannon entropy of the image palette, measuring the degree of orderliness of an image is not just limited to the scope before and after image compression. Known an image itself palette Shannon entropy $H(X_{RGB})$, you can first determine the range of color types used, which is equivalent to give a palette of a priori knowledge, and then determine the degree of orderliness of its image. The degree of orderliness at this point is called the Shannon entropy orderliness, and its value can be used with the known palette Shannon entropy $H(X_{RGB})$ of the image [19]. Its formula is expressed as follows:

$$M_H = \frac{N \times H(X_{RGB}) - K(I)}{N \times H(X_{RGB})} \tag{16}$$

where $K(I)$ is the compression ratio of the image, N is the total number of samples, and the Shannon entropy ordering degree M_H is the degree of ordering derived given a known palette distribution, which reflects the regularity of the distribution of colors on the canvas.

2.3.3. Complexity of the work. Let an image consist of N pixel points, each pixel point can be understood as a small region, and if each region is filled with a different color value, it forms a picture. In the information theoretic approach, an information channel is used to realize the transfer of information between regions and pixel values in an image. The input of this channel is a random variable C and the output is a random variable R, where C represents the distribution of colors in the image, and similarly, R represents the distribution of different color regions in the image, and the correlation between the color C and the region R in the image is represented by the interaction information $I(C,R)$, which can be obtained from Eq. (17):

$$I(C,R) = \sum_{c \in C} p(c) \sum_{r \in R} p(r \mid c) \ln \frac{p(r \mid c)}{p(r)} \tag{17}$$

The ratio MI of the interaction information $I(C,R)$ to the Shannon entropy $H(C)$ of the whole image is used as a threshold for determining whether it is a homogeneous region or not. When the neighboring pixel point of a region with its MI value is less than the given threshold, this pixel point is considered to be homogeneous with this region, otherwise it is heterogeneous. Since the final segmentation of the image is obtained from MI, its inverse function can be used to find out the number of blocks n for the final division, which is expressed by the following formula:

$$n = MI^{-1}\left(\frac{I(C,R)}{H(C)}\right) \tag{18}$$

In the division process, the amount of mutual information needs to be calculated repeatedly. If the three primary color RGB channels are used, it will make the computation quite large and the operation time is quite long, so in this paper, we use the luminance space X_L to compute $I(C,R)$ and $H(C)$, and the higher the complexity, the more details of this work.

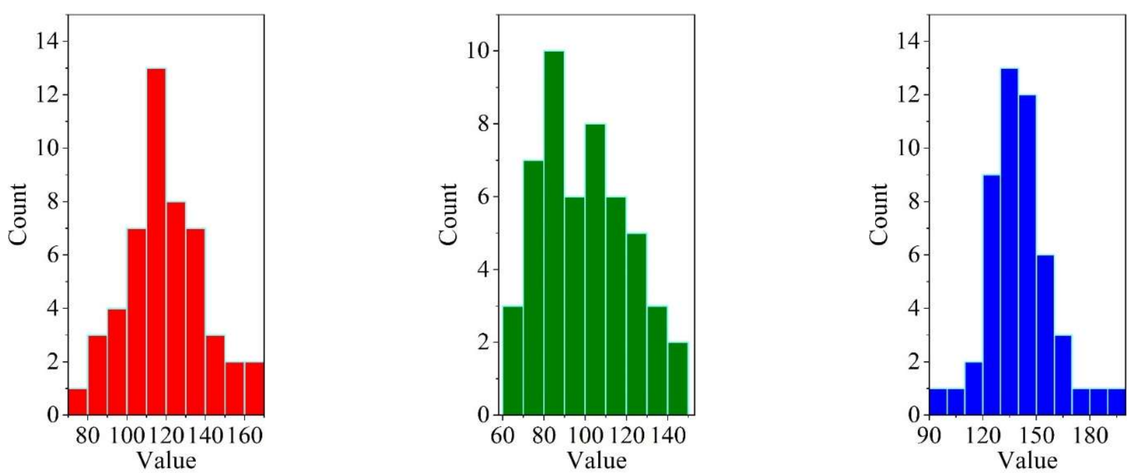
3. Analysis of quantitative studies of stylistic differences among artists

3.1. Color Redundancy Analysis

3.1.1. Purpose of the experiment. In order to test the information theory model based on the stylistic differences between Giacometti and his contemporaries proposed in this paper, in this regard, the redundancy theory of the palette in the information theory model theory was applied to analyze the color redundancy of images of the works of Giacometti and his contemporaries (Picasso), respectively.

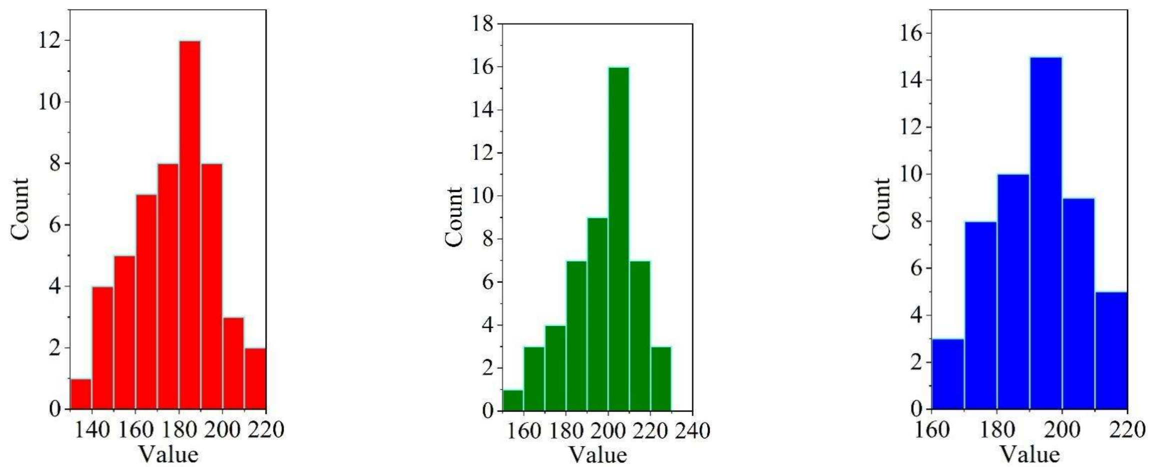
3.1.2. Experimental parameters. In this paper, the experimental samples come from a classical art website, the number of images of Giacometti's works is 50, and the number of works with Picasso is also 50, and the cut-off category is 50, and the experimental analysis platform is Matlab, and the experimental hardware platform is an Intel Core i7-12700KF processor, an NVIDIA GeForce RTX 4060 Ti graphics card × 2.32 GB memory computer, the operating system is Windows 11, the software implementation language is python.

3.1.3. Experimental results. Color redundancy features are the most widely used redundancy features, color redundancy features have a small dependence on the size, orientation and viewing angle of the image itself, and have a good robustness on their own. When dealing with color redundancy features, the system automatically builds a histogram to count the number of occurrences of each color, and the statistical tool utilized is the RGB color tool, Figure 1 shows the RGB color histogram of Giacometti's works, and Figure 2 shows the RGB color histogram of Picasso's works, in which (a) to (c) are R (red), G (green), and B (blue), respectively. Each color in the color histogram possesses 255 color intervals. The three color intervals add up to a total of 768 dimensions, and no special dimensionality reduction is required. It can be clearly observed that the RGB values of Giacometti's works are distributed in the interval of [60, 200], while the RGB intervals of Picasso's works are [140, 240], which makes it possible to intuitively see the difference between the colors of the two works in a quantitative form.



(a)Red (b)green (c)Blue

Fig. 1. RGB color histogram of Giacometti's work



(a)Red (b)green (c)Blue

Fig. 2. RGB color histogram of Picasso's work

After the RGB values of the works are known, on the basis of which the Shannon entropy formula (7) above is applied to find the palette Shannon entropy $H(X_{RGB})$, and the palette redundancy of the works of Giacometti and Picasso is calculated based on the formula (15), with $H_{\max}$ in the formula set to 32 (which has been given in detail in section 2.3), and the results of palette redundancy for the works of Giacometti and Picasso are shown in Table 1. The palette redundancy results of Giacometti and Picasso's works are obtained as 0.611 and 0.485 respectively, which clearly shows that the entropy of the quantitative value of palette redundancy is greater for Giacometti's works than for Picasso's works, which means that Giacometti dares to boldly experiment with different color combinations than Picasso, and so Giacometti's works have a higher degree of color redundancy.

Giacometti:

$$M_B = \frac{H_{\max} - H(X_{RGB})}{H_{\max}} = \frac{32 - 12.457}{32} = 0.611 \tag{19}$$

Picasso:

$$M_B = \frac{H_{\max} - H(X_{RGB})}{H_{\max}} = \frac{32 - 16.481}{32} = 0.485 \tag{20}$$

Table 1. Palette redundancy results

Artwork	$H(X_{RGB})$	$H_{\max}$	M_B
Giacometti	12.457	32	0.611
Picasso	16.481	32	0.485

3.2. Shannon entropy ordering degree analysis

3.2.1. Image Compression Ratio. With the development of information technology, image transmission has become an important element of data communication. Unlike textual information, images are characterized by a large amount of data and redundancy. If the image data is not compressed, the huge amount of data is difficult to be stored, processed and transmitted on computer systems and networks. Image compression and coding is to transform and combine the data of images according to certain rules, so as to achieve the purpose of representing as much information as possible with as few symbols as possible. Shannon entropy coding is a distortion-free coding method, which is completely based on the statistical characteristics of the image. The basic principle is that symbols with higher probability are given a short code word and symbols with lower probability are given a long code word in order to make the final average code length the shortest, so that the threshold coding not only preserves the low-frequency components, but also certain high-frequency components are selected to be coded, and the quality is improved when reconstructing the image. Using Shannon entropy for image compression of Giacometti and Picasso works respectively, the image compression ratio is analyzed as shown in Fig. 3, the horizontal axis is the image compression ratio and the vertical axis is the distortion rate of the image. Based on points A and B in the figure, it can be seen that when the image compression ratios of Giacometti and Picasso's works are 400 and 540, respectively, the corresponding image distortion rate is 0, which greatly restores the authenticity of the works, and provides data support for the subsequent analysis of the degree of order of the art works.

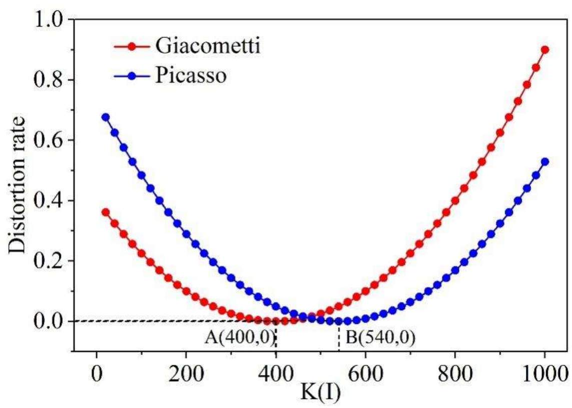


Fig. 3. Image compression ratio analysis

3.2.2. Orderliness analysis. On the level of knowing the optimal image compression ratio of the works of Giacometti and Picasso, the Shannon entropy ordering degree of the works of Giacometti and Picasso is obtained by using the formula (16) respectively, and the results of the analysis of the Shannon entropy ordering degree are shown in Table 2. According to the size of the data in the table, it can be seen that the Shannon entropy orderliness of Giacometti's works is 0.0131 higher than that of Picasso's works, which indicates that the color distribution of Giacometti's and Picasso's works is less regular, and it can better highlight the individual painting style. Giacometti's repeated and complicated strokes and the technique of "traces on traces" are all time records left on the screen through visual observation, and he synthesizes the unique elements in different time and space to build a new structural order, thus reflecting the objective existence of time, with a higher degree of overall orderliness. Picasso, on the other hand, often discarded superfluous, dispensable contents that were not directly related to the subject, and transformed them into free, virtual associative space by way of white space, presenting a sense of uncertainty of plausibility and uncertainty, with a lower degree of order in the overall performance.

Giacometti:

$$M_H = \frac{N \times H(X_{RGB}) - K(I)}{N \times H(X_{RGB})} = \frac{50 \times 12.457 - 400}{50 \times 12.457} = 0.3578 \tag{21}$$

Picasso:

$$M_H = \frac{N \times H(X_{RGB}) - K(I)}{N \times H(X_{RGB})} = \frac{50 \times 16.481 - 540}{50 \times 16.481} = 0.3447 \tag{22}$$

Table 2. Shannon entropy order degree analysis results

Artwork	N	$H(X_{RGB})$	$K(I)$	M_H
Giacometti	50	12.457	400	0.3578
Picasso	50	16.481	540	0.3447

3.3. *Analysis of work complexity*

According to the formula for calculating the complexity of works outlined in subsection 2.3.3, the complexity of 50 Giacometti and Picasso artworks can be derived, and the results of the analysis of the complexity of the works are shown in Table 3. Among the 50 Giacometti artworks, the minimum value of complexity is 446, the maximum value of complexity is 990, and the corresponding average value is 718. whereas the minimum, maximum, and average values of Picasso's artworks' complexity are 207, 991, and 596, respectively, which summarizes that some of the Picasso artworks are more complex than Giacometti's artworks, but the overall complexity of the 50 Giacometti artworks is greater than that of the Picasso, Giacometti artworks pay more attention to painting details (color, line, sense of space), while Picasso's later artworks are more abstract, resulting in lower complexity.

Table 3. Work complexity analysis results

Artwork	Complexity of Giacometti's works	Complexity of Picasso's works	Artwork	Complexity of Giacometti's works	Complexity of Picasso's works
1	604	991	26	657	818
2	860	590	27	537	959
3	559	789	28	844	311
4	662	676	29	932	355
5	740	335	30	694	531
6	507	435	31	610	846
7	926	691	32	789	967
8	631	909	33	846	756
9	990	408	34	820	952
10	889	688	35	721	216
11	972	840	36	509	207
12	576	930	37	550	510
13	931	721	38	804	717
14	662	731	39	587	556
15	493	491	40	512	428
16	703	355	41	572	664
17	446	420	42	839	898
18	875	356	43	875	327
19	912	880	44	493	892
20	867	653	45	487	483
21	762	665	46	661	408
22	573	217	47	727	286
23	885	515	48	689	571
24	581	484	49	946	938
25	833	224	50	772	219

4. Conclusion

In this paper, within the scope of big data technology, with the help of information theory, from the perspective of color redundancy, order, and complexity of works, we explore the difference between the styles of Giacometti and his contemporaries.

1) The entropy of the quantitative value of color palette redundancy is greater in Giacometti's works (0.611) than in Picasso's works (0.485), and the value of the difference between the two is 0.126. In terms of the color matching, Giacometti dares to boldly experiment with different color combinations than Picasso.

2) The order of Shannon entropy of Giacometti's works is 0.0131 higher than that of Picasso's works, the difference between the two is not significant, and the order of both artworks is lower, Giacometti's use of repetitive and complicated strokes and the “traces stacked on traces” technique, the overall order is higher, and Picasso's overall use of the white space to transform it into a free, virtual associative space, which is a free, virtual space. Picasso transforms it into a free and virtual association space by means of white space, showing a lower degree of order.

3) The overall complexity of the 50 art works of Giacometti (718) is greater than that of Picasso (596). Giacometti's mastery of the details of the art works is extremely horrible, while Picasso's late art works abandon the basic structure of paintings (color, line, sense of space) and convey more of a free and democratic philosophical thought, so Picasso's late art works are more abstract, resulting in a lower degree of complexity of the works.

References

[1] Mathews, T. (2013). Alberto Giacometti: The art of relation. Bloomsbury Publishing.

[2] Poling, C. V. (2016). Giacometti and Sartre: On Drawing. Master Drawings, 477-490.

[3] RILKE, M., & BOURGEOIS, L. (2016). ALBERTO GIACOMETTI, RAINER. Art and Mourning: The role of creativity in healing trauma and loss, 13.

[4] Giacometti, A., & Di Crescenzo, C. (2016). Alberto Giacometti: In His Own Words: Sculptures 1925-34. Luxembourg & Dayan.

[5] Laughton, B. (2009, June). Giacometti's final frenzy: the paintings of Caroline: for five years, from 1960 to 1965, Giacometti was obsessed with painting his final muse, a prostitute known as Caroline. Bruce Laughton explores the development of these powerful and moving portraits of a woman who described herself as the artist's' frenzy'but showed no interest in the works. In Apollo (Vol. 169, No. 566, pp. 48-56). Apollo Magazine Ltd.

[6] Rae, J. (2016). A Giacometti portrait, postmodern emergence, and creativity. Methodological Innovations, 9, 2059799116672876.

[7] McKendrick, J. (2017). Discomfort ye: Alberto Giacometti's stations on the route to perception. TLS. Times Literary Supplement, (5964), 20-21.

[8] Lucas, T. (2016). Giacometti's gaze. The Lancet, 387(10014), e6-e7.

[9] Jedlińska, E. (2021). A discourse between and about two artists: Alberto Giacometti and Francis Bacon. Art Inquiry, (23), 215-238.

[10] Wenjun, Z. H. U. (2020). Bodies in Samuel Beckett’s Theatre from the Perspective of Alberto Giacometti’s Sculptures. Journal for Literary and Intermedial Crossings, 5, e1.

[11] Wilson, L. (2008). The Power of Visual Memory: The Earliest Remembered Drawing of Alberto Giacometti, Snow White in Her coffin. The Psychoanalytic Quarterly, 77(2), 477-505.

[12] Heathcote, C. (2013). When Beckett Commissioned Giacometti. Quadrant, 57(1/2), 68-76.

[13] Wiesinger, V. (2011, April). Giacometti in Switzerland: for much of his life Giacometti discouraged the perception of himself as a Swiss artist, posing for the press only in his Paris studio. During his final years,

however, he embraced his local roots to savour both global and national acclaim. In Apollo (Vol. 173, No. 586, pp. 28-34). Apollo Magazine Ltd.

[14] SCHULMAN, R. (2023). The Architecture of Cities: LA Art World and the Giacometti Face. CounterPunch.

[15] Shaw, J. (2016). Critically discuss the development of Giacometti's process of portrait painting. Word count: 3296.

[16] Sollars, M. D. (2013). Kafkaesque Absurdity in the Aesthetics of Beckett and Giacometti. Enthymema, (8), 71-82.

[17] Diane Le Roux,Sylvain Serra,Sabine Sochard & Jean Michel Reneaume. (2024). Sensibility analysis and environmental impact of a system combining a solar-assisted heat pump and PCM storages. Energy Conversion and Management119108-119108.

[18] Huang Shisong,Li Danyang,Zhang Zhuhong,Wu Yating,Tang Yumei,Chen Xing & Wu Yiqing. (2023). CSLSEP: an ensemble pruning algorithm based on clustering soft label and sorting for facial expression recognition. Multimedia Systems(3),1463-1479.

[19] Unnikrishnan Nair N.,Sunoj S. M. & G. Rajesh. (2023). Cumulative residual entropy of equilibrium distribution of order;n. Communications in Statistics - Theory and Methods(3),851-863.