

Art & Perception

Calligraphy and Klee's Abstract Painting. A Study on Categorical Ambiguity

--Manuscript Draft--

Manuscript Number:	ARTP-1040R1
Full Title:	Calligraphy and Klee's Abstract Painting. A Study on Categorical Ambiguity
Short Title:	Calligraphy and Klee's Abstract Painting.
Article Type:	Special Issue: Morphologies
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Keywords:	Abstract Painting; Categorical ambiguity; Klee; Shodo; Visual appearances
Funding Information:	

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Calligraphy and Klee's Abstract Painting

A Study on Categorical Ambiguity

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1 **Abstract**

2 The study analyses the categorical ambiguity between visual appearances that belong in different
3 categories, such as Oriental Calligraphy and certain Abstract Paintings selected from the works of
4 Klee. In particular, the aim of our research was to identify whether there exist abstract features at
5 the basis of purely visual configurations that determine the way in which they are categorized.
6 Specifically, the intention was to determine whether, and to what extent, two artistic forms that
7 display documented shared graphic and conceptual characteristics differ, or do not differ, visually,
8 and whether certain features exist that identify them as a specific type of graphic work. The
9 assumption that both categories had shared characteristics that made them graphically and
10 conceptually similar and resulted in categorical ambiguity was confirmed. Moreover, the presence
11 of some constituent features specific to one or the other was also confirmed. The results show
12 that a Calligraphic Image and an Abstract Painting by Klee can be “exchanged”, but the tendency
13 to confuse Calligraphy with an Abstract Painting is greater than that of confusing an Abstract
14 Painting with Calligraphy.

15 **Key words:** Abstract Painting; Categorical ambiguity; Klee; Shodo; Visual appearances

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17

1 **1 Introduction**

2 A critical issue in the analysis of visual space is the difference among *optical space* (generally
3 identified with the space of physics), *phenomenal space* (the anisotropic space of figural and
4 chromatic appearances), and *pictorial space* (as regards both painting and other visual arts)
5 (Albertazzi 2006). Recent studies in vision science have evidenced the several relationships
6 between visual and pictorial space (Koenderink, van Doorn 2006; Koenderink, van Doorn,
7 Wagemans 2012, 2014; Koenderink 2015), highlighting how visual space and pictorial space, from
8 the viewpoint of the beholder, are both widely virtual. On the one hand, in seeing we frequently
9 perceive optical illusions, apparent motion events, distortions of Euclidean shapes, illusory
10 surfaces, and chromatic dislocations; and we have many other perceptions odd from the point of
11 view of physics. Put briefly, the space of vision is largely anisotropic, qualitative, only apparently
12 Euclidean, un-homogeneous, and viewer dependent, which may imply great variability among
13 perceivers. On the other hand, pictorial space is able to ‘deceive’ the viewer as well, as classically
14 occurs in trompe l’oeil: in Metzger’s terms, pictorial space is but a visual space with a lesser degree
15 of reality (Metzger 1941). Phenomenal space and pictorial space share several perceptual
16 characteristics that, especially in abstract art, have been analyzed and exemplified in detail
17 (magnified, one would say), and which makes their study feasible from a scientific visual viewpoint
18 (consider the symmetries). One example is the role and the complexity of visual lines in drawing
19 (Kandinsky 1926; Klee 1961; Ruskin 1857). From this perspective, it is of interest to conduct
20 comparison between Oriental Calligraphy and some works by Paul Klee, because of their apparent
21 similarity in visual appearances. It is not by chance that *Shodo* (literally, “the way of writing”) is
22 described as a type of Abstract Painting (Keene, cit., in Fortarezza, Kimura 1988). In Japanese
23 calligraphy (Harada 2011; Hideo 2000; Nagayama 2012; Stevens 1996; Suzuki 2005), the characters are
24 divided into seven groups based on the simplified shape of an object (*shōkei moji*, pictographs), on
25 abstract symbols representing forms of shapes (*shiji moji*), and on semantic composites that may
26 combine two or more characters of the former and latter type (*kai'i moji*). The smallest unit of a
27 kanji is *kaku* (stroke, character), which may in turn be of eight different types (*jikaku*) taking the
28 shape of a comma (*ten*), a horizontal line (*yokosen*), a vertical line (*tatesen*), a diagonal line
29 (*nanamesen*), a line with a hook (*kadokagi*); a line with a sharp hook (*nanamekagi*), a curve, and a
30 line created by combining a curve and a sharp hook (*ahiru*). It is therefore not difficult to see the
31 relationship of *Shodo* with the formal studies on lines conducted by Kandinsky at the beginning of
32 the twentieth century (1926), and by Klee (1961), where particularly line performs a fundamental,

1 dynamic role in making natural shapes visible. The similarity increases when considering Klee's late
2 works, when the line assumes a marked aspect of stroke. Shodo incorporates the concept of time
3 (the intrinsic rhythm of *kanji*), and it is a provider of emotional and cross-modal values due to the
4 simultaneous presence of opposing attributes such as positive and negative, static and dynamic,
5 empty and full, light and dark, smooth and rough, soft and rigid, or rounded and angular, which
6 follow a precise order of composition.

7 Klee's interest in calligraphy and the influence of Japonism on many aspects of his artistic work has
8 been well-documented (see, for example, the recent exhibition mounted in 2013 at the Zentrum
9 Paul Klee, *Von Japonismus zu Zen. Paul Klee und der ferne Osten*; see also Okuda, Kaninuma 2012).
10 Eleven of Klee's works, painted between 1912 and 1913, were inspired by Japanese art, and the
11 influence of calligraphy is evident in his poetic paintings and in works such as *Once Emerged from*
12 *the Grey of Night* (1918), *Abstract Writing* (1931), and *Virgin* (1932), and in his use of Japanese
13 calligraphy paper, on which he composed 173 works between 1911 and 1940. In particular, his
14 final work, with its unavoidable stress on the figural features of line becoming a stroke, also
15 accentuates its emotional and figural characteristics (www.zpk.org). For Klee, as for Shodo, every
16 line, every stroke has its own order, form, slope, meaning, and rhythm. The influence of music on
17 early twentieth century avant-garde Abstract Painting, and on Kandinsky and Itten, is well known
18 with particular regard to Schönberg (Bidaine 2004; Schönberg, Kandinsky 1980); and it was
19 especially powerful in the case of Klee, who was a skilled musician. The intrinsically temporal and
20 cross-modal nature of the line is described by Klee himself when he talks in terms of a "first half
21 beat", "rhythm of two beats out of three", "light, and very slow" and so on; Greenberg (1941) has
22 defined Klee's painting as rhythmic calligraphy (see also Overmeyer 1982). Certain works, such as
23 *Fugue in Red* (1921), *Polyphony* (1921), and *White Framed Polyphonically* (1939), even include a
24 musical reference in their names.

25 A characteristic of Klee's works is the idea that the world of nature and abstract geometric forms
26 have features in common. A further important characteristic of both Shodo and Klee's works is the
27 idea that designing a line or a stroke is like objectivizing oneself on a sheet of paper (see also
28 Tanchu 2004): an artist creates nature; s/he does not imitate it.

29 The nature of calligraphy has recently been considered in terms of perceptive balance by a study
30 on experimental aesthetics (Gershoni, Hochstein, 2011). Our study considers the role of strokes in
31 calligraphy and the works of Klee, and compares the ways in which they are produced, our
32 purpose being to identify any features that might be responsible for differences or similarities

1 between them, and therefore the categorical identity of their respective configurations. The
2 similarity between the strokes in calligraphy and Klee's works of art has been tested making use of
3 subjects naïve to Kanji, so that they could reach both Abstract Painting and Kanji as proto-figural,
4 purely visual patterns, without any top-down influences. Obviously, a test conducted with subjects
5 educated in a kanji-based language would not possible, because it is unlikely that they would
6 confuse Calligraphy with Abstract Painting.

7

8 **2 The Study**

9 The research reported here analysed the categorical ambiguity between visual appearances that
10 belong in different categories, such as Oriental Calligraphy and certain Abstract Paintings taken
11 from the works of Klee. In particular, our aim was to identify whether there exist abstract features
12 at the basis of purely visual configurations that determine the way in which they are categorized.

13 The research therefore analysed the visual relationship between Japanese calligraphy and Klee's
14 Abstract Paintings from the point of view of sign features, especially strokes, and the
15 configurations in which they appear. The intention was to determine whether, and to what extent,
16 two artistic forms that display documented shared graphic and conceptual characteristics differ, or
17 do not differ, visually, and whether certain characteristic features exist that identify them as a
18 specific type of graphic work. Our research was carried out in two phases: in the first, the task was
19 purely visual (Experiment no. 1); in the second we used Osgood's semantic differential
20 (Experiment no. 2), with a hard-copy follow-up. Both experiments were preceded by a pilot test.

21

22 **3 Experiment No. 1**

23 Participants were shown on a monitor images taken from calligraphic art and certain of Klee's
24 paintings in random order and for a very short time. The aim was to analyse the subjects' correct
25 or mistaken identification of an image or a graphic category and to establish whether there were
26 features distinctive and fundamental to the categorical choice.

27 The guiding hypothesis behind the experiment was that, given the structural similarity between
28 Oriental Calligraphy and Abstract Painting, a participant might be "induced into error", and
29 attribute an Abstract Painting to the Calligraphic Image category and vice versa. If this were to
30 happen, one would expect to be able to identify the features from the two types of stimulus that
31 bring about attribution to one category or the other.

32

1 *3.1 Pre study*

2 The experiment was preceded by a pilot test using twelve subjects to establish the appropriate
3 time period within which to present the images. The only exclusion criterion was a knowledge of
4 oriental calligraphy. The task consisted in associating a certain image with its corresponding
5 graphic category: Abstract Painting or Calligraphy. Thirty images were shown on a monitor and
6 viewed by each individual participant: fifteen images from Japanese calligraphic art, and fifteen
7 paintings by Klee. The calligraphic images were Kanj, Kana, and Shibunsho.

8 *3.2 Methods*

9 *Participants*

10 Sixty-four volunteer students took part in the study: fifty females and fourteen males (average age
11 = 21.85, standard deviation = 2.49, age range = 19-29). The participants were recruited from the
12 Department of Psychology and Cognitive Sciences of the University of Trento. The experiment was
13 carried out in accordance with the relevant institutional and national regulations and legislation,
14 and with the World Medical Association Helsinki Declaration as revised in October 2008. The
15 experiment was conducted after obtaining informed consent from the participants. The only
16 exclusion criterion for all subjects was a self-declaration that they had knowledge of oriental
17 languages. Only one subject declared a previous school-based experience in art.

18 *Materials*

19 The materials used in the experiment consisted of thirty black and white images, of which fifteen
20 were works by Klee (Fig. 1) and fifteen were examples of Shodo (Fig. 2). MATLAB 2010 software
21 was used on a Quato Display 242 computer, with IntelliProof 242 Excellence monitor calibration
22 and Silver Haze Pro & DTP94-LCD device selection.

23 FIGURE 1 – INSERT HERE

24 FIGURE 2 – INSERT HERE

25 The images used were presented in black and white if they included chromatism, and Klee's
26 signature was removed from the abstract painted images. All the images were entered into
27 software created using the Matlab programme. Since the sizes of the images differed, we re-sized
28 them (maintaining their proportions) so that their area did not exceed one third of the entire area of the
29 screen (52 x 32.6); and they were balanced so that they were equal to each other, and in order to
30 conform with the size of the monitor. Software resolution was 1920x1200 pixels, with a frequency
31 of 59.92 Hz. In the attached online file, the images have their actual dimensions]]

32

1 *Procedures*

2 The experiment was conducted at the CIMeC Laboratory in Rovereto. The lighting in the
3 laboratory, which was from a halogen lamp (1 lux on the walls), was kept constant. The distance
4 between the subject and the computer screen was 60 cm.

5 During the experiment, a black screen first appeared (for 1500 ms), followed by a screen
6 containing the image to be identified (visible for 150 ms), then another black screen (for 210 ms),
7 and then the answer screen, which disappeared when the subject expressed his or her choice of
8 categorical attribution.

9 This screen was organized into two sessions. The answer screen consisted of a semi-circular arch
10 with seven points, at the extremes of which was typed "AP" (meaning Abstract Painting) on the
11 left and "CALL" (meaning Calligraphy) on the right for session 1, and "CALL" (on the left) and "AP"
12 (on the right) for session 2. The two sessions were alternated: for example, subject 1 was given
13 session no. 1, subject 2 was given session no. 2, subject 3 was given session no. 1, and so on.

14 The participants in the experiment had to indicate the category to which the image was to be
15 attributed by selecting one of the seven points in the semicircular arch. The participants did not
16 know either the total number of images or the proportion of Abstract Painting/Calligraphy. There
17 was an interval of 150 ms between the answer screen and the subsequent image.

18 The instructions given to each subject were as follows:

19 *Images will be visualized on the screen. For each image that you see, you will be asked to identify*
20 *whether it is a Calligraphic Image or an image from an Abstract Painting. After each image, an*
21 *answer screen will appear consisting of a semicircular arch consisting of 7 small circles. At one end*
22 *there will be the word "Calligraphy" and at the other "Abstract Painting", or vice versa. Your task*
23 *will therefore be to select the small circle which indicates both the category to which you believe*
24 *the image you have seen belongs, and the degree of certainty of your judgement. If you are totally*
25 *undecided about the category, you can choose the central circle.*

26 The subject then saw the image and assigned it to what he or she believed was the category to
27 which it belonged, also indicating his/her degree of certainty.

28 *Statistical Methods*

29 The results were analysed using descriptive statistics. The exact binomial test was employed to
30 test hypothesis for a single proportion. For each image an accuracy score was calculated, as
31 described in the results, and a z test was conducted to test if the mean accuracy score was equal
32 to zero. Analyses were performed using R 3.0.0 software (R Core Team, 2013).

1 3.3 Results

2 Table 1 shows the overall classification of the images made by the subjects. Overall, in 143 out of a
3 total of 1920 choices (7.4%), subjects were entirely uncertain as to whether the image was
4 calligraphic or painted. On considering only these cases, one might expect the image to be
5 calligraphic on half of these occasions and painted on the other half. However, the image was
6 Calligraphic 84 times (58.7%) and an Abstract Painting 59 times (41.3%). An exact binomial test
7 carried out to verify the null hypothesis that the two proportions were both 50% produced a (two
8 sided) p-value of 0.044; it was therefore possible (at a 5% level of significance) to reject the null
9 hypothesis that in a situation of maximum uncertainty the subjects were equally undecided when
10 a Calligraphic Image or an Abstract Painting was presented. The results showed that this situation
11 was more likely when a Calligraphy was shown.

12 TABLE 1 – INSERT HERE

13 In the remaining 1777 cases (i.e. when subjects classified images as calligraphic or painted), there
14 were a total of 358 misclassifications (20.1%). One would expect half of the misclassifications to
15 occur in the Calligraphy category and the other half in the Abstract Painting category. On the other
16 hand, on 258 occasions (72.1%) a calligraphic image was classified as a painting and in the
17 remaining 100 cases (27.9%) a pictorial image was classified as calligraphic. An exact binomial test
18 carried out to verify the null hypothesis that the two percentages were both 50% ruled out this
19 hypothesis ($p < 0.001$). The results showed that, when a misclassification was made, it was 2.58
20 times more likely that a calligraphy had been confused with a painting.

21 The previous results were obtained by aggregating the choices of all the 64 subjects. When the
22 choices of each subject were considered, there were 27 subjects who misclassified only
23 calligraphic images; 22 other subjects who mainly misclassified calligraphic images, while 7
24 subjects made the same number of misclassifications (calligraphic as painted and painted as
25 calligraphic). There were only 8 subjects who mainly misclassified painted images.

26 If the level of certainty in the choice (high, intermediate, low) was considered, and if Calligraphic
27 Images and Abstract Paintings were treated separately, the results shown in Table 1 were
28 obtained.

29 In the former case, only 278 Calligraphic Images were correctly identified as such and with a high
30 degree of certainty (i.e. 29.0% of the Calligraphic Images). Therefore 71.0% of these images were
31 misclassified, not classified, or classified as Calligraphic Images but with a certain degree of
32 uncertainty. In the latter case (Abstract Paintings), 387 images were correctly identified as such

1 and with a high degree of certainty (i.e. 40.3% of the pictorial images). Therefore, 59.7% of these
2 images were misclassified, not classified, or classified as pictorial images but with a certain degree
3 of uncertainty.

4 In order to take into account the level of certainty of each participant in indicating the category to
5 which the image was to be attributed, an accuracy score was calculated. A weight 1 was assigned
6 when the level was maximum (i.e. when the subject selected the most extreme point in the arch),
7 a weight 1/3 when the level was minimum (i.e. when the subject selected the third or the fifth
8 point in the arch), and a weight 2/3 when the level was intermediate (i.e. when the subject
9 selected the second or the sixth point in the arch). When a subject was entirely unable to make a
10 decision (i.e. when the subject selected the central point of the arch), a score of 0 was attributed.
11 Furthermore, when a subject misclassified an image, a negative sign was given to the score. Table
12 2 shows the mean values of these scores image by image in ascending order. To be noted is that
13 four images (all calligraphic) had a negative score. Therefore, on the average, these calligraphic
14 images were classified as pictorial.

15 TABLE 2 – INSERT HERE

16 A z-test was performed to evaluate whether the mean score of a given image could be considered
17 not significantly different from 0. In calculating the standard error of the test, the variance was
18 assumed to be 0.572. This value was calculated assuming that a subject randomly classified a given
19 image attributing, also randomly, a level of certainty, using the same proportion of the total
20 sample (i.e.: maximum level: 41%; intermediate level: 31%; minimum level: 21%; no choice: 7%).
21 The results of this test are shown in Table 2 (under the column heading “z”).

22 It is worth noting that there were three images (10 Call, 1 Call, and 4 Call) that on average were
23 “significantly” misclassified, since their mean values were negative and significantly different from
24 zero. There were five other images (9 Call, 8 Call, 3 Call, 6 AP, 11 Call) whose mean values of the
25 accuracy score were not significantly different from zero; in this case the hypothesis of a random
26 attribution cannot be ruled out. Four of these images were calligraphic.

27 In some cases a subject was unable to make a choice, being entirely undecided in classifying a
28 given image as calligraphic or pictorial. This striking feature was more evident for image 8 Call,
29 when 19 out of 64 subjects (30%) were unable to make a choice (see Table 3).

30 TABLE 3 – INSERT HERE

31 In addition to the number (and the percentage) of no choices, Table 3 also shows how many times
32 each image was (mis)classified as calligraphic or pictorial. No image was always correctly classified.

1 For four images (shown in bold in Table 3) the percentage of misclassification was higher than
2 50%; these images were all calligraphic.

3 *3.4 Discussion*

4 In light of the data collected, it is possible to state that a Calligraphic Image and an Abstract
5 Painting can be “exchanged”, but the tendency to confuse Calligraphy with an Abstract Painting is
6 greater than that of confusing an Abstract Painting with Calligraphy.

7 Given the likelihood that the subjects would be induced into an “error”, with regard to the
8 categorical choice between Oriental Calligraphy and Abstract Painting, the hypothesis that both
9 categories had shared characteristics that made them graphically and conceptually similar and
10 resulted in categorical ambiguity was confirmed. On the other hand, the presence of some
11 constituent features specific to one or the other was also confirmed. We therefore wanted to
12 investigate what the shared features might be, and also what was most characteristic of the two
13 different types of graphic work.

14 Analysis of the images suggested that there were features that induced categorial errors (in both
15 Klee’s paintings and Calligraphy), and features that induced indecision in the subjects. Analytically,
16 it seems that features shared by the erroneous choices consisted in marked and incisively
17 dominant aspects, while the vertical or horizontal direction of the configuration seemed to have
18 no influence.

19 In the choices characterized by randomness, once again it seems that the vertical or horizontal
20 direction of the configuration did not have particular weight, although a slight prevalence towards
21 horizontality was apparent. However, since randomness cannot be ruled out, it was not possible
22 to identify shared features, which could appear light or heavy, static or dynamic in the various
23 images.

24 In the choices characterized by indecision, the same considerations apply to the random choices,
25 the prevalence towards horizontality was further accentuated (four images out of six). To sum up,
26 certain features can be identified from the choices that were made. Some features appear to have
27 been perceived by the subjects as most characteristic of one category or the other, and motivated
28 their attribution. Specifically, iconicity, narrativity, and horizontality (Fig. 4) were perceived as
29 dominant features of art, while (ii) calligraphic style and verticality (Fig. 3) were perceived as
30 dominant features of Calligraphy. At the same time, the subjects were unable to classify a large
31 percentage of images, which confirms the thesis of the ambiguity of the two categories considered
32 (Calligraphy and Abstract Painting). In all the cases of indecision, in fact, although similar and

1 incisive features can be identified among subgroups of images that were classified as such, it is
2 not possible to construct a general categorization of them. In order to shed more light on the
3 classification, and specifically to investigate whether it would be possible identify the features
4 responsible for the wide ambiguity, we decided to perform a second experiment, using the
5 Osgood semantic differential method.

6

7 **4 Experiment no. 2**

8 A second experiment, using the same stimuli, was carried out employing Osgood's semantic
9 differential. In this experiment each image remained on the screen until the participants had
10 completed their attribution of the listed adjectives referring to the image being observed.

11 4.1 Pre study

12 A pilot test was carried out on thirteen subjects, who performed the experiment on thirty-eight
13 adjectives, selecting the twenty-two deemed most representative. The only exclusion criterion
14 was a knowledge of Oriental Calligraphy. The task consisted in associating a certain image with a
15 certain adjective. The following categories were retained: fragmented, impression of three-
16 dimensionality, impression of horizontality, impression of verticality, heavy, light, complex, sad,
17 happy, incisive, static, normal, powerful, weak, calm, agitated, soft, luminous, cyclical, presence of
18 dominant aspects, western, and informative.

19 4.2 Methods

20 *Participants*

21 Sixty volunteer students took part in the study: forty-eight females and twelve males (average age
22 = 21.85, standard deviation = 2.49, age range = 19-29). The participants were mainly recruited
23 from the Department of Psychology and Cognitive Science of the University of Trento. The
24 experiment was carried out in accordance with the relevant institutional and national regulations
25 and legislation, and with the World Medical Association Helsinki Declaration as revised in October
26 2008. The experiment was conducted after obtaining informed consent from the participants. The
27 only exclusion criterion for all subjects was a self-declaration that they had knowledge of oriental
28 languages. No subject, apart from one, declared any previous school-based experience in art.
29 Forty-five of them had also taken part in experiment no. 1 one week previously.

30 *Materials*

31 The images used were the same as those employed in the previous experiment. Unlike in the first
32 experiment, two PC screens were used: one projected the visual images, while adjectives referring

1 to the image being observed scrolled on the other. The categories for the semantic differential
2 analysis related to expressive properties (for example, cold/hot, or heavy/light) or to emotional
3 connotations (for example, sad/happy), and were also chosen according to the strong cross-modal
4 connotation (visual and musical) present in both the calligraphic works and those by Klee.

5 A continuous bipolar scale (between 0 and 1) was used so as to render the method as “visual” as
6 possible. The subjects moved a bar across a horizontal line and positioned it at the level selected.

7 *Procedures*

8 The experiment was divided into two parts: in the first, participants were asked to give their
9 subjective judgments by moving the bar along a continuous bipolar scale located below the
10 category. At the beginning and end of the bar, two terms (“not at all” and “extremely”) were used
11 to indicate the two extremes. Based on the category and the image shown on the screen, the
12 participants indicated their choices by moving the bar towards “extremely” to show maximum
13 agreement with that term with regard to that image, or towards “not at all” to indicate complete
14 disagreement. By then clicking on the “send” key, the final score given on the bipolar scale was
15 acquired from the system and the participants moved on to the next category, with a total of
16 twenty-two (identical) sets of categories for each image. At the end of the list of categories, the
17 image changed. The same process was followed for all the remaining images.

18 As a follow-up, the thirty images were printed on paper on conclusion of the experiment, and the
19 participants were asked to circle what they considered to be the dominant aspects in the image
20 and to offer an interpretation of them. If participants either did not find a dominant part in the
21 figure or were unable to describe what it represented to them, they could abstain from
22 responding.

23 *Statistical Methods*

24 To compare the mean scores for each adjective within the two groups of images (Calligraphic vs
25 Abstract Painting), the Student’s t test for unpaired data was employed. The p -value of the test
26 was calculated using the Bonferroni correction. To assess similarities and differences among the
27 thirty images based on the levels given to the adjectives, we employed a hierarchical cluster
28 analysis. The twenty-two average levels (calculated for the sixty subjects) attributed to the twenty-
29 two adjectives were associated with each image. Cluster analysis makes it possible to group a
30 collection of observations together so as to minimize the “distance” between the groups that are
31 gradually formed. The purpose is to identify homogeneous groups from which a “taxonomy” may
32 be inferred.

1 *4.3 Results*

2 Table 4 shows the average scores given on the bipolar scale by the sixty subjects to the twenty-
3 two categories for the fifteen Calligraphic Images and fifteen Abstract Painting images, together
4 with the result of the statistical comparison.

5 TABLE 4 – INSERT HERE

6 A statistically significant difference between the average level given to the various categories
7 emerged for the first eleven terms reported in Table 4. For example, the level of the adjective
8 “incisive” was significantly different for Calligraphy and Abstract Painting: Calligraphy had an
9 average incisiveness of 0.60, whereas that of Abstract Painting was 0.48. Conversely, there was no
10 statistically significant difference among the remaining eleven terms. The results obtained for the
11 first eleven adjectives in Table 4 show that, compared with Abstract Painting, the Calligraphic
12 Images were relatively more vertical, powerful, incisive, calm, heavy, and static. On the other
13 hand, compared with the Calligraphic Images, the Abstract Painting images were relatively more
14 horizontal, weak, agitated, light, and cyclical.

15 *Cluster analysis*

16 In order to identify homogeneous groups of images with regard to their adjectival characteristics,
17 a hierarchical cluster analysis was carried out. The results are illustrated in Fig. 3. If one observes
18 the distances between the groups that are gradually formed (shown on the vertical axis in the
19 Figure), three distinct groups (identified in the figure by three ovals) seem to emerge.

20 FIGURE 3 – INSERT HERE

21 In order to characterize these three groups taxonomically, Table 5 shows the average scores for
22 each adjective within these three groups.

23 TABLE 5 – INSERT HERE

24 The first group consists of 10 Call, 3 Call 11 Call, 8 Call, 5 AP, 3 AP, 12 AP, and 4 AP. If we take an
25 average of 0.5 as the threshold value (that is, the central value of the interval within which the
26 subjects were requested to make their selection), we can say that the first group is made up of
27 images characterized by high values given to the terms: impression of horizontality, powerful,
28 incisive, presence of dominant aspects. These results confirm the results of Experiment no. 1
29 (where these images were either pictorial or calligraphic but with the characteristic of indecision),
30 but give more information on the other semantic dimensions of shapes such as appearing
31 agitated, heavy, and sad.

1 The second group consists of 7 AP, 6 AP, 12 Call, 15 Call, 8 AP, 9 AP, 11 AP, 1 AP, and 7 Call. If we
2 once again use the 0.5 threshold, we find that the second group is composed of images
3 characterized by high values given to the adjectives: impression of verticality, fragmented,
4 agitated, luminous, complex, and light.

5 Finally, the third group consists of 13 AP, 4 Call, 1 Call, 15 AP, 5 Call, 6 Call, 13 Call, 2 Call, 10 AP, 4
6 Call, and 14 AP. As before, we can say that the third group is composed of images characterized by
7 high values given to the categories: impression of verticality, presence of dominant aspects,
8 incisive, powerful, and normal. When these results are compared with those of experiment no. 1,
9 the following observations can be made. Grouped in the first cluster are the images that exhibit
10 distinctive features of a pictorial type. In fact, this includes numerous images by Klee (2 AP, 3 AP, 4
11 AP, 5 AP and 12 AP), among which there are the two recognized as being mostly such (5 AP, 4 AP).
12 Moreover, it includes calligraphic images such 11 Call, 8 Call and 9 Call, that had been classified in
13 indecision/random categories.

14 In the second cluster there are images belonging to the Abstract Painting category (1 AP, 2 AP, 6
15 AP, 7 AP, 8 AP, 9 AP, 11 AP) which did not have high significance in the classification of figural
16 features, but which on the basis of the categories selected for the differential semantic analysis
17 exhibited some shared characteristics. From this second experiment, therefore, we obtained
18 further information on the categorization of images of Abstract Painting.

19 The third cluster comprises mostly calligraphic images (1 Call, 2 Call, 4 Call, 5 Call, 6 Call, 9 Call, 13
20 Call, 14 Call), and among them, those that had been classified as the most calligraphic (6 Call, 13
21 Call and 14 Call).

22 *4.4 Hard copy follow-up*

23 As to the final paper follow-up, the thirty images were printed on paper and the participants were
24 asked to circle what they considered to be the dominant aspects in the image and to offer an
25 interpretation of them.

26 In the case shown in Fig. 4 (Klee, *Der Zusammenbruch der biblischen Schlange*), for example, the
27 participants described the image as: a hanged person, a stylized small man, a suffering man, etc.,
28 evidencing the presence of *paired* features, *anthropomorphic* features (eyes, faces), *animal*
29 features, and *expressive* features expressing predominantly negative tertiary emotional qualities
30 (fear, sadness, anger, or anxiety).

31 FIGURE 4 – INSERT HERE

1 As a second example, in the case shown in Fig. 5 (Yonekura Taiken, *Horse*), the subjects evidenced
2 the presence of *pairs of similar* features, *anthropomorphic* features (eyes, faces), and *animal*
3 features.

4 FIGURE 5 – INSERT HERE

5 Specifically, paired features of similar elements were identified in 1 Call, 7 Call, 2 Call e 7 Call (not
6 present in the first experiment among the images most characterized as calligraphic), 3 AP, 10 AP,
7 14 AP e 5 AP (the last two were the most pictorial in the first experiment). Animal features were
8 emphasised in 1 Call, 3 AP, 1 AP, 5 AP, 4 AP, 2 Call, 4 Call, 12 AP, 11 AP, 14 AP, 5 Call, 13 AP, 15
9 AP, 7 Call, 9 Call, 6 Call, 8 Call, 10 Call, 12 Call, 15 Call, and 14 Call. Anthropomorphic features were
10 emphasised in 1 Call, 3 AP, 5 AP, 4 AP, 2 Call, 4 Call, 12 AP, 11 AP, and 15 AP. Emotional features
11 were emphasised in 3 AP, 4 AP, 8 AP, 12 AP, 4 Call and 9 Call (partially overlapping with the
12 anthropomorphic features).

13

14 **5 General Discussion**

15 Our research analysed the visual relationship between Japanese Calligraphy and some works of
16 Klee's Abstract Painting, two artistic forms that display documented shared graphic and
17 conceptual characteristics. We wanted to test whether, and to what extent, they differ, or do not
18 differ, *visually*, and whether certain features exist that identify them as a specific meaningful
19 shapes in pictorial space. Our research was carried out in two phases, the first purely visual, and
20 the second using Osgood's semantic differential. The second experiment had a hard-copy follow-
21 up.

22 In light of the data collected, it is possible to claim that a Calligraphic Image and an Abstract
23 Painting can be "exchanged", and that there is a greater tendency to confuse Calligraphy with an
24 Abstract Painting than an Abstract Painting with Calligraphy. The feature responsible for the
25 tendency is evidenced in the cases where there was indecision in the choice.

26 Pictorial images (as one would expect) are strongly characterized by figurative and narrative
27 features. Calligraphic Images sharing these features were in fact strongly misclassified and
28 ascribed to Abstract Painting. By using the Osgood semantic differential, in comparison with the
29 Calligraphic Images, the Abstract Painting images were relatively more horizontal, weak, agitated,
30 light, and cyclical. As to Calligraphic Images, they were characterized by a plurality of elements,
31 the absence of iconic features (as expected), and verticality. By using the Osgood semantic
32 differential, in comparison with the pictorial images, Calligraphic Images were classified as being

1 relatively more vertical, powerful, incisive, calm, heavy, and static. Finally, the cluster analysis in
2 the second experiment revealed a specificity in the three clusters. A plurality of elements,
3 together with narrow brushstrokes and verticality, were seen as features that tended to identify
4 Calligraphy. On the other hand, the existence of only two distinct and separate elements in a
5 configuration was not perceived as a feature identifying either Calligraphy or Abstract Painting.

6 The work of Klee, strongly influenced by Japonism, has in its turn strongly influenced Japanese art.
7 Well known is Klee's influence (especially that of his *Ad Marginem* from 1930 and *The Whole is*
8 *Dimming* and *Nordzimmer* from 1932) on Tōru Takemitsu's musical compositions (see his *Distance*
9 *de Fée*, 1951; on Japanese poetry (especially on the works of Shuntarō Raniwaka, see his *Klee*
10 *Angel*, 2000); on cartoons (see «Kurē na hito» (*Klee'scher Mensch*) by Kazuya Takahashi); on
11 architecture (see the work of Toyo Ito, which accomplishes an abstraction of spaces with
12 characteristics of shapes and their dematerialization visible in the Kaohsing National Stadium or
13 the Nantes School of Architecture); and on Leiko Ikemura's analysis of the corporeality and
14 measurability of sensible spaces, as in the *Ocean* project (Leiko, Malsch, Brofen 2002).

15 The purpose of our study, however, extends beyond artistic interest. In fact, once it is realized that
16 both visual space and pictorial space are not strictly Euclidean spaces, because they are
17 dimensional, coloured, textured, expressive, crossmodal and inherently dependent on the
18 perception of the beholder, the question arises as what primitives, characteristics, and laws
19 regulate their organization. From this point of view, Klee's pictorial work is a kind of 'laboratory'
20 for the identification and construction of a genetic geometry of visual appearances (Albertazzi,
21 2013). The idea that as soon as a line is drawn, be it angular, continuous, chromatic or achromatic,
22 a surface potentially develops (an idea already put forward in Alberti's *De Pictura*) was subject to
23 study in all Klee's works (see, for example, *Raumbildung durch Bewegte Gerade* 1931)
24 (Bätschmann 2002). Pictorial analyses of further expressive and crossmodal features of the line
25 have obviously been conducted by other exponents of Western abstract art, such as Kandinsky,
26 Schiele and Marc, whose works analyse and depict specific characteristics of the line, such as
27 rhythmic, expressive, chromatic, and depth inducing. The specificity of Klee's work, however,
28 consists in the rootedness of the abstract primitives of drawing in the morphology of natural
29 shapes (Klee, 1970), thus providing a viable working hypothesis for identification of the geometry
30 of visible space.

31

1 **Acknowledgements.** We would like to thank *Zentrum Paul Klee* and *Associazione Archivio Storico*
2 *Olivetti* for permission to use and reproduce the images used in our experiments. In the Appendix
3 we present the original images of Klee's paintings by courtesy of *Zentrum Paul Klee*.

4

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28
29

1 LEGENDS OF THE FIGURES

2

3 Figure 1. The images refer to the following works by Klee, in order: 1. Patetische Lösung, 2.
4 Vorsicht Schlangen, 3. Der Zusammenbruch der biblischen Schlange, 4. Ohne Titel-a, 5. Ohne Titel-
5 b, 6. Stillleben mit Trieben, 7. Bewachung, 8. O! die Stelle jener Gegend, 9. Grenze, 10. Fall-
6 Bäume, 11. Ein Amphibien-Streitross, 12. Verzweifelt rudern, 13. Assel, 14. Verletzt, 15.
7 Paukenspieler.

8 Permission to reproduce the images was kindly granted by the Zentrum Paul Klee, Berne.

9

10 Figure 2. The images were taken from Fortarezza and Kimura (1988), and are, in numerical order:
11 1. Horse, Yonekura Taiken, kanji; 2. Killing two birds with one stone, Kubo Kinkei, kanji; 3.
12 Distracting attention, Takayama Keitei, kanji; 4. Seven letters of the week representing the Earth
13 and the Universe, Maruyama Michiyo, kanji; 5. The stage of the gods, Itoh Shunrei, shibunsho (in
14 gyosho style); 6. The delicious fascination of China, Takazawa Nansoh, kanji in gyosho; 7. The
15 flowered dress, Harada Masaroh, kanji; 8. Shining, Watanabe Bokusen, kanji; 9. Aspiration, Iijima
16 Shunkei, shibunsho; 10. The sun in one's heart, Sasaki Seiyoh, shibunsho; 11. Sitting, Takeuchi
17 Taisoh, kanji; 12. O, wind, if winter comes, can spring be far behind? Shizu Keisui, shibunsho; 13.
18 Auspicious clouds float in the sky, Tanaka Suishuh, kanji; 14. Chrysanthemums, Asada Gyokusetsu,
19 kanji; 15. Snow falling in an ever-deepening silence /In the sky, the cry of the kite, Masuoka
20 Hohshoh, kana. The majority were therefore kanji and shibunsho characters. Permission to
21 reproduce the images was kindly granted by the Associazione Archivio Storico Olivetti.

22

23 Figure 3. Results of the cluster analysis.

24

25 Figure 4. Example of features circled as being most distinctive (Klee, *Der Zusammenbruch der*
26 *biblischen Schlange*).

27

28 Figure 5. Example of features circled as being most distinctive (Yonekura Taiken, *Horse*).

29

30

31

1 LEGEND OF THE FIGURES IN THE APPENDIX

2 Figure A1. Original works by Paul Klee identified by the Obj.Id tracking number as assigned by the
3 *Zentrum Paul Klee*, Bern.

4 **Obj.Id 8578:** pathetische Lösung, Pathetic solution, 1939, 498; watercolour on paper on
5 cardboard; 21.5 x 27 cm; Privatbesitz Schweiz, Depositum im Zentrum Paul Klee, Bern.

6 **Obj.Id 8428:** vorsicht Schlangen!, Caution, snakes!, 1938, 419; coloured paste and pastel on paper
7 on cardboard; 20.8 x 29.7 cm; Zentrum Paul Klee, Bern, Livia Klee Donation.

8 **Obj.Id 326:** (Metamorphosen:) der Zusammenbruch der biblischen Schlange, (Metamorphoses:)
9 the collapse of the biblical serpent, 1940, 324; coloured paste on paper on cardboard; 34.2 x 49.3
10 cm; Zentrum Paul Klee, Bern.

11 **Obj.Id 406:** Ohne Titel, Untitled, um 1940; coloured paste on paper on cardboard; 50 x 65 cm;
12 Zentrum Paul Klee, Bern.

13 **Obj.Id 408:** Ohne Titel, Untitled, um 1940; coloured paste on paper; 20.1 x 28.8 cm; Zentrum Paul
14 Klee, Bern.

15 **Obj.Id 8513:** Fall-Bäume, Descending trees, 1939, 280; coloured paste on paper on cardboard;
16 20.9 x 29.7 cm; Zentrum Paul Klee, Bern, Livia Klee Donation.

17 **Obj.Id 1526:** Stilleben mit Trieben, Still life with young shoots, 1938, 265; watercolour on paper on
18 cardboard; 27 x 21.4 cm; Zentrum Paul Klee, Bern.

19 **Obj.Id 1527:** Bewachsung, Overgrowth, 1938, 266; watercolour on paper on cardboard; 27 x 21.5
20 cm; Zentrum Paul Klee, Bern.

21 **Obj.Id 1273:** Grenze, Border, 1938, 37; coloured paste on paper on cardboard; 50 x 35.4 cm;
22 Zentrum Paul Klee, Bern.

23 Figure A2. Original works by Paul Klee identified by the Obj.Id tracking number as assigned by the
24 *Zentrum Paul Klee*, Bern.

25 **Obj.Id 352:** ein amphibien-Streitross, An amphibious warhorse, 1940, 350, coloured paste on
26 paper on cardboard; 20.9 x 29.4 cm; Zentrum Paul Klee, Bern.

27 **Obj.Id 349:** verzweifelt rudern, Rowing desperately, 1940, 347, coloured paste on paper on
28 cardboard; 20.9 x 29.5 cm; Zentrum Paul Klee, Bern, Livia Klee Donation.

29 **Obj.Id 288:** Assel, Woodlouse, 1940, 287, coloured paste on paper on cardboard; 29.6 x 41.6/41.8
30 cm; Privatsammlung, Bern.

31 **Obj.Id 1300:** O! die Stelle jener Gegend, Oh! the place of that region, 1938, 67, coloured paste on
32 paper on cardboard; 28 x 17.9 cm; Zentrum Paul Klee, Bern.

- 1 **Obj.Id 318:** verletzt, Injured, 1940, 316, coloured paste on paper on cardboard; 41.7 x 29.5 cm;
- 2 Zentrum Paul Klee, Bern.
- 3 **Obj.Id 271:** Paukenspieler, Kettledrummer, 1940, 270, coloured paste on paper on cardboard; 34.6
- 4 x 21.2 cm; Zentrum Paul Klee, Bern.
- 5

Table 1. Overall classification made by the subjects relatively to the images

Type of image	Type of choice						nc [°]
	Calligraphic Image			Abstract Painting			
Calligraphic Image	618	High	278	258	High	92	84
		Intermediate	191		Intermediate	91	
		Low	149		Low	75	
Abstract Painting	100	High	27	801	High	387	59
		Intermediate	31		Intermediate	276	
		Low	42		Low	138	

[°] no choice (nc): number of times that subjects were completely uncertain on the classification
 High, intermediate, low: degree of certainty on the classification

Table 2. Mean (and standard deviation) of the accuracy score of each image. (Call: Calligraphic Image. AP: Abstract Painting).

Image ID	mean	sd	z [°]	p ^{°°}
6 Call	0.828	0.351	8.76	<0.001
4 AP	0.807	0.389	8.54	<0.001
13 Call	0.781	0.372	8.26	<0.001
5 AP	0.719	0.342	7.60	<0.001
13 AP	0.714	0.456	7.55	<0.001
12 AP	0.703	0.385	7.44	<0.001
14 Call	0.698	0.384	7.38	<0.001
3 AP	0.688	0.415	7.27	<0.001
12 Call	0.667	0.490	7.05	<0.001
8 AP	0.646	0.428	6.83	<0.001
5 Call	0.609	0.516	6.45	<0.001
15 Call	0.609	0.466	6.45	<0.001
2 Call	0.599	0.437	6.34	<0.001
7 AP	0.599	0.453	6.34	<0.001
10 AP	0.599	0.532	6.34	<0.001
14 AP	0.583	0.479	6.17	<0.001
9 AP	0.578	0.508	6.12	<0.001
15 AP	0.552	0.551	5.84	<0.001
11 AP	0.510	0.600	5.40	<0.001
2 AP	0.438	0.554	4.63	<0.001
7 Call	0.432	0.466	4.57	<0.001
1 AP	0.344	0.566	3.64	0.008
11 Call	0.271	0.591	2.86	0.125
6 AP	0.198	0.596	2.09	> 0.5
3 Call	0.177	0.645	1.87	> 0.5
8 Call	0.146	0.582	1.54	> 0.5
9 Call	-0.219	0.609	-2.31	> 0.5
4 Call	-0.344	0.534	-3.64	0.008
1 Call	-0.443	0.557	-4.68	<0.001
10 Call	-0.479	0.588	-5.07	<0.001

°: Result of the z test to verify if the true accuracy score is zero.

°°: p-values calculated employing the Bonferroni correction

Table 3. Number (and percentage) of classifications of each image in the three categories: Calligraphic Image (Call), Abstract Painting (AP), no choice.

Image ID	Calligraphic		Abstract Painting		No choice	
	n	%	n	%	n	%
8 Call	31	48.4	14	21.9	19	29.7
11 Call	40	62.5	12	18.8	12	18.8
9 Call	18	28.1	36	56.3	10	15.6
2 AP	9	14.1	45	70.3	10	15.6
4 Call	9	14.1	46	71.9	9	14.1
6 AP	19	29.7	37	57.8	8	12.5
14 AP	6	9.4	52	81.3	6	9.4
3 Call	38	59.4	20	31.3	6	9.4
2 Call	55	85.9	3	4.7	6	9.4
10 AP	6	9.4	53	82.8	5	7.8
7 AP	6	9.4	53	82.8	5	7.8
1 AP	14	21.9	45	70.3	5	7.8
15 Call	56	87.5	4	6.3	4	6.3
10 Call	12	18.8	48	75.0	4	6.3
8 AP	3	4.7	57	89.1	4	6.3
5 Call	54	84.4	6	9.4	4	6.3
3 AP	3	4.7	57	89.1	4	6.3
7 Call	54	84.4	7	10.9	3	4.7
5 AP	1	1.6	60	93.8	3	4.7
1 Call	12	18.8	49	76.6	3	4.7
15 AP	8	12.5	54	84.4	2	3.1
13 AP	3	4.7	59	92.2	2	3.1
13 Call	60	93.8	2	3.1	2	3.1
12 AP	3	4.7	59	92.2	2	3.1
11 AP	9	14.1	53	82.8	2	3.1
12 Call	57	89.1	6	9.4	1	1.6
9 AP	7	10.9	56	87.5	1	1.6
6 Call	61	95.3	2	3.1	1	1.6
14 Call	61	95.3	3	4.7	0	0.0
4 AP	3	4.7	61	95.3	0	0.0

Table 4. Average scores (and standard deviations) given by the subjects for each of the twenty-two adjectives to the fifteen Calligraphic Images and to the fifteen Abstract Painting images.

Adjective	Calligraphic Image		Abstract Painting		t	p ^o
	mean	s.d.	mean	s.d.		
Powerful	0.610	0.288	0.475	0.309	-8.05	<0.001
Incisive	0.597	0.291	0.478	0.304	-7.93	<0.001
Weak	0.239	0.226	0.310	0.272	6.44	<0.001
Agitated	0.442	0.321	0.538	0.324	5.85	<0.001
Calm	0.416	0.307	0.339	0.296	-5.56	<0.001
Impression of horizontality	0.403	0.365	0.486	0.359	5.54	<0.001
Impression of verticality	0.639	0.340	0.552	0.349	-5.30	<0.001
Heavy	0.475	0.334	0.377	0.315	-4.99	<0.001
Cyclical	0.280	0.255	0.331	0.283	4.03	0.004
Light	0.349	0.292	0.408	0.315	3.96	0.004
Static	0.365	0.350	0.318	0.340	-3.43	0.025
Luminous	0.434	0.270	0.481	0.281	2.85	0.132
Complex	0.523	0.300	0.466	0.309	-2.81	0.149
Western	0.334	0.342	0.441	0.311	2.37	0.466
Fragmented	0.433	0.302	0.469	0.319	2.34	0.493
Sad	0.391	0.311	0.409	0.314	1.28	> 0.5
Presence of dominant aspects	0.541	0.319	0.561	0.331	1.25	> 0.5
Happy	0.356	0.278	0.371	0.309	1.13	> 0.5
Soft	0.355	0.283	0.340	0.288	-0.98	> 0.5
Three-dimensional depth	0.279	0.282	0.291	0.296	0.87	> 0.5
Informative	0.399	0.323	0.411	0.316	0.63	> 0.5
Normal	0.438	0.307	0.435	0.310	-0.16	> 0.5

^o: Result of the Student's t test for paired data

^{oo}: p-values calculated employing the Bonferroni correction

Table 5. Mean (and standard deviation) of the score for each adjective in the three groups of images identified by the cluster analysis.

Adjective	Group 1 (n=8)		Group 2 (n=10)		Group 3 (n=12)		F°	p°°
	mean	s.d.	mean	s.d.	mean	s.d.		
Agitated	0.597	0.154	0.586	0.065	0.339	0.096	20.12	<0.001
Light	0.238	0.050	0.519	0.077	0.356	0.132	18.65	<0.001
Calm	0.270	0.104	0.322	0.078	0.496	0.099	16.44	<0.001
Static	0.338	0.119	0.232	0.058	0.435	0.078	15.43	<0.001
Normal	0.409	0.117	0.345	0.067	0.531	0.061	14.90	0.001
Fragmented	0.385	0.137	0.617	0.135	0.356	0.094	14.51	0.001
Luminous	0.354	0.073	0.552	0.055	0.448	0.097	14.11	0.001
Heavy	0.568	0.096	0.282	0.078	0.451	0.151	13.73	0.002
Incisive	0.645	0.051	0.420	0.099	0.563	0.108	13.72	0.002
Powerful	0.675	0.080	0.432	0.093	0.547	0.131	11.35	0.006
Happy	0.283	0.050	0.476	0.098	0.323	0.116	10.61	0.009
Sad	0.502	0.072	0.308	0.068	0.408	0.113	10.42	0.010
Impression of verticality	0.402	0.092	0.577	0.148	0.739	0.209	10.12	0.012
Impression of horizontality	0.641	0.096	0.422	0.126	0.332	0.202	9.59	0.016
Soft	0.246	0.045	0.410	0.075	0.364	0.107	8.86	0.024
Weak	0.200	0.028	0.338	0.083	0.270	0.077	8.64	0.028
Cyclical	0.273	0.058	0.365	0.046	0.277	0.064	8.31	0.034
Presence of dominant aspects	0.629	0.086	0.464	0.141	0.571	0.103	5.02	0.308
Informative	0.456	0.172	0.308	0.126	0.452	0.100	4.21	> 0.5
Western	0.444	0.090	0.368	0.066	0.367	0.091	2.48	> 0.5
Complex	0.431	0.056	0.544	0.094	0.495	0.148	2.25	> 0.5
Three-dimensional depth	0.309	0.076	0.271	0.056	0.281	0.143	0.31	> 0.5

°: Result of the F test

°°: p-values calculated employing the Bonferroni correction



1AP



2AP



3AP



4AP



5AP



6AP



7AP



8AP



9AP



10AP



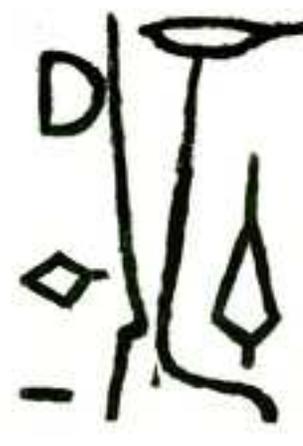
11AP



12AP



13AP

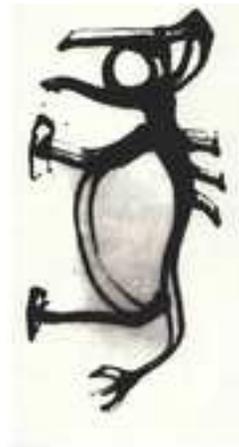


14AP



15AP

Figure 2
[Click here to download high resolution image](#)



1 Call



2 Call



3 Call



4 Call



5 Call



6 Call



7 Call



8 Call



9 Call



10 Call



11 Call



12 Call



13 Call



14 Call



15 Call

Figure 3

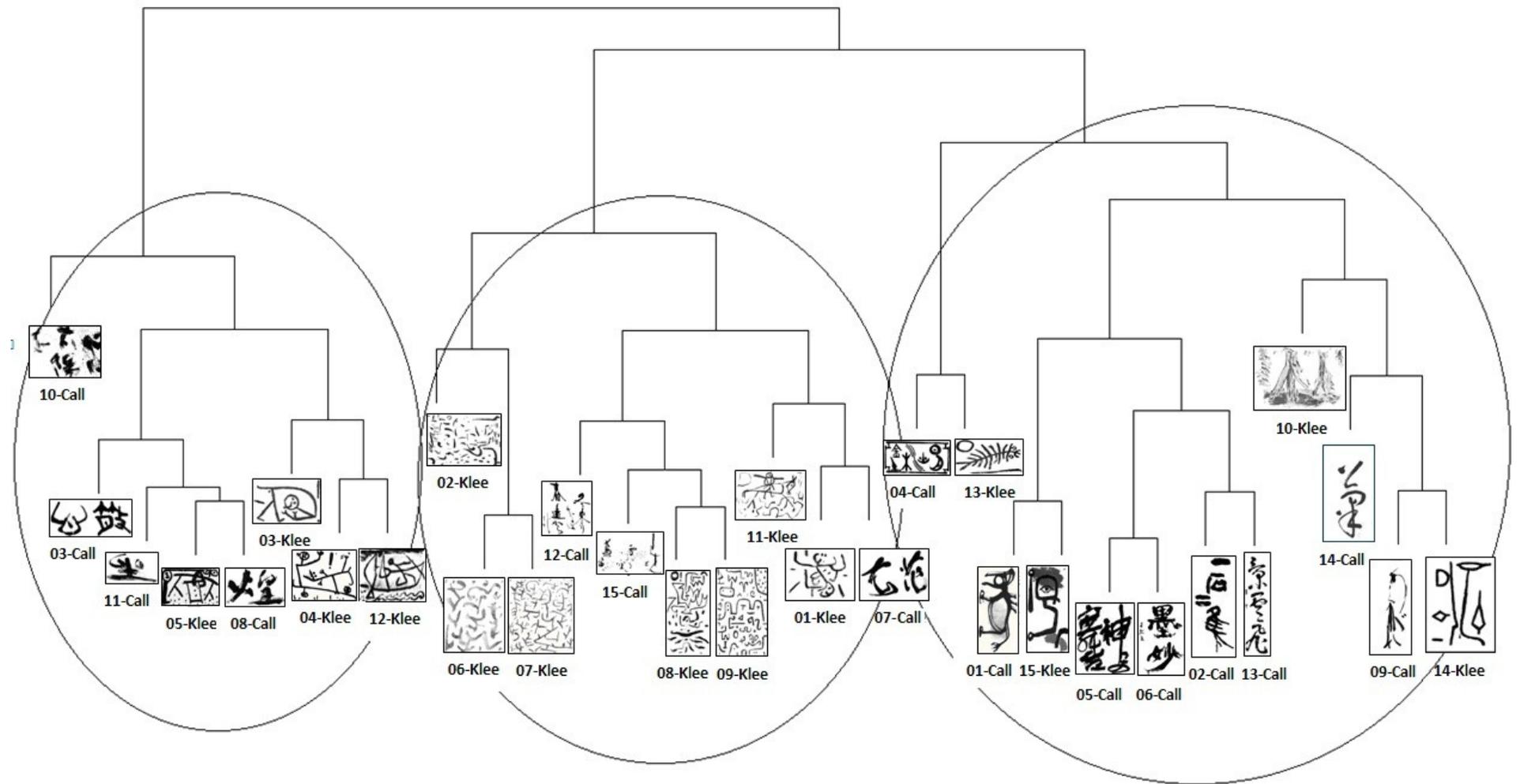


Figure 4
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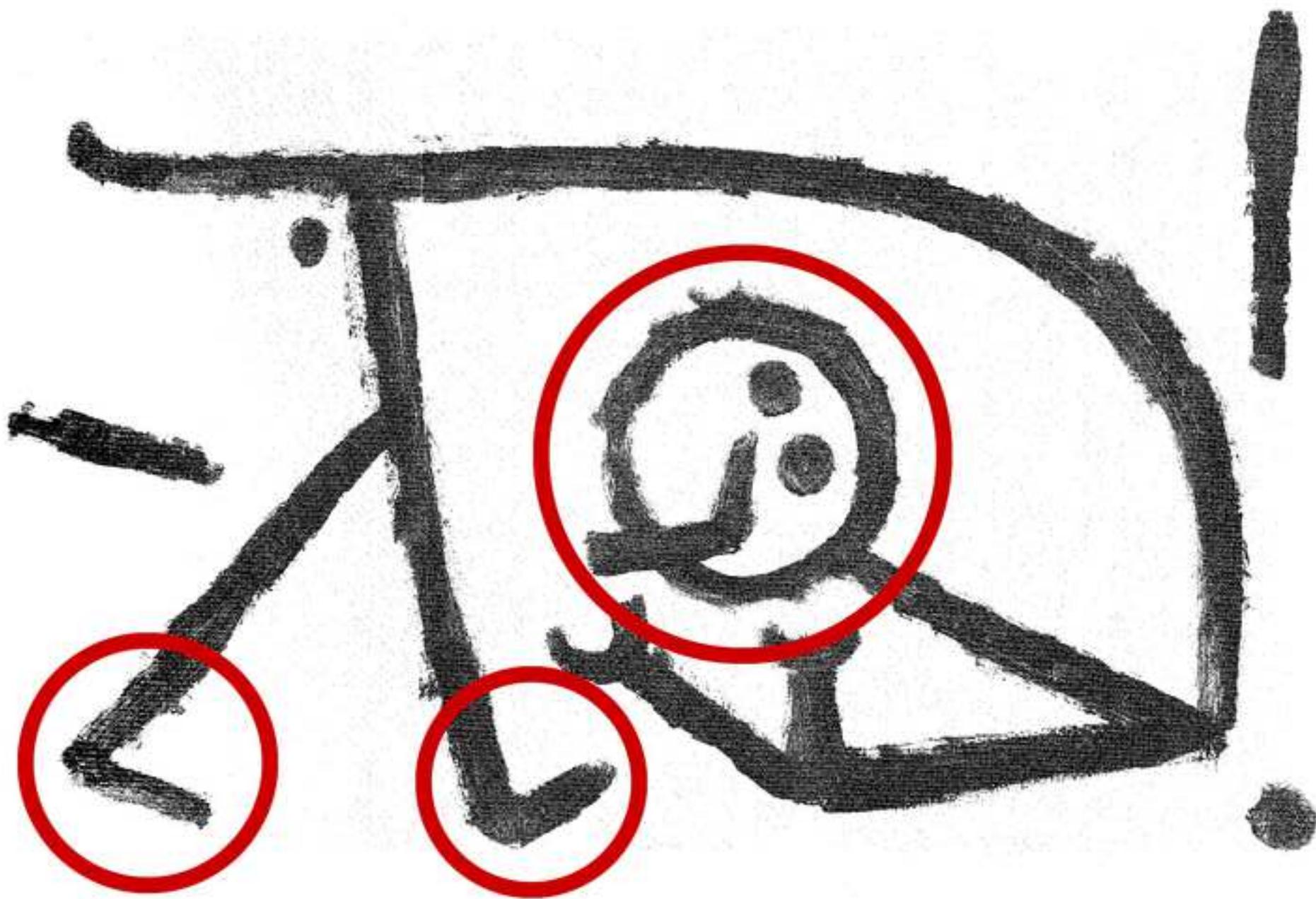
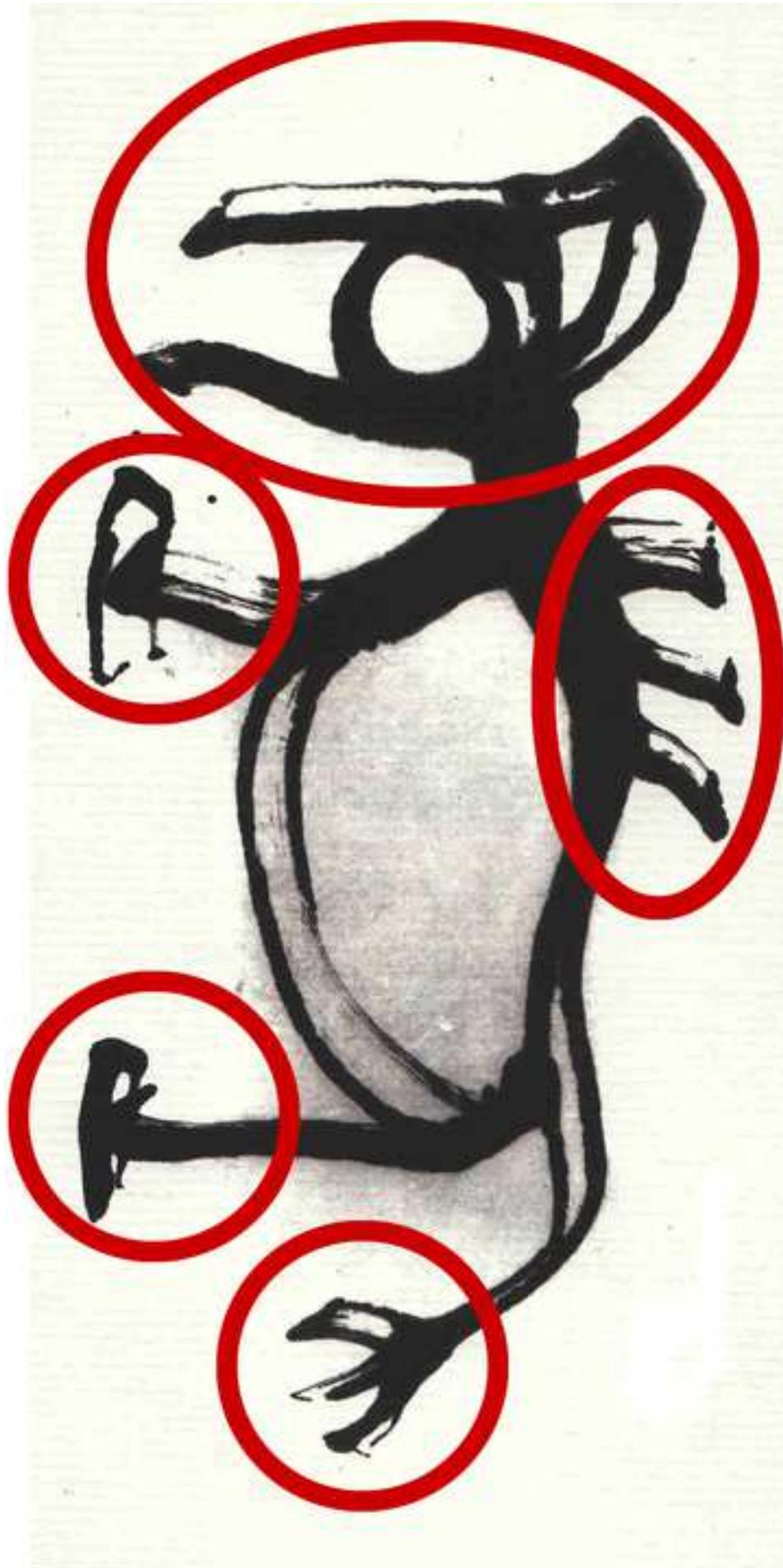
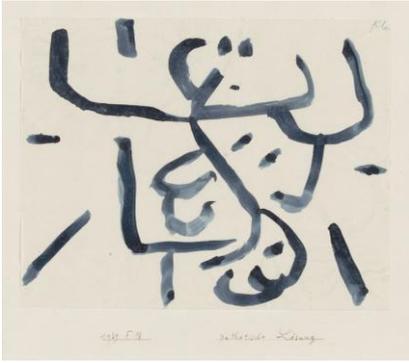


Figure 5
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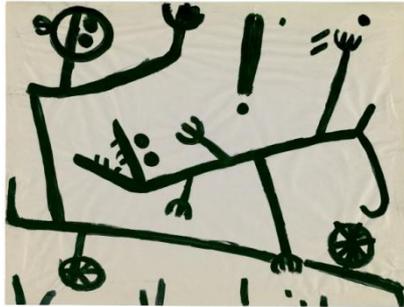
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8428



326



406



408



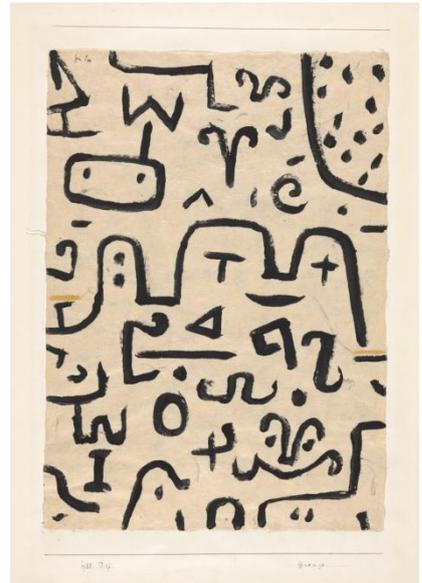
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1526



1527



1273



352



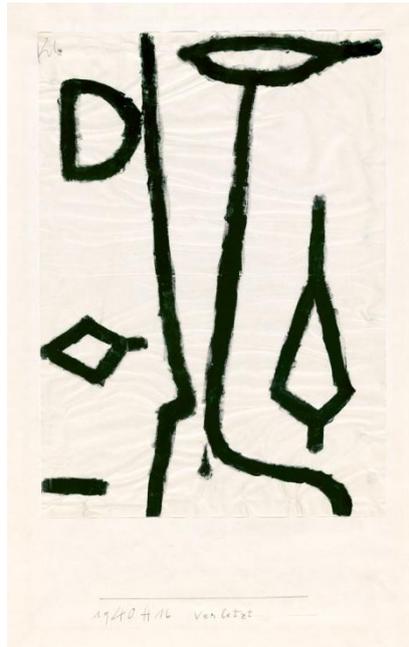
349



288



1300



318



271