A RELATIVE RESEARCH ON AFFECTIVE RESPONSE FROM FORM COMPOSITION FEATURE

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Abstract: The “overall form” of an object comprises form elements that are combined using composition features. In this study, form composition was divided into different items and categories by using form principles, the Semantic Differential evaluation and content analysis method were employed to analyze the form composition. In addition, the Pleasure–Arousal affective space was adopted to facilitate classification and comprehensive analysis. The results of the affective response of form composition was generalized into four features governing form composition in the P-A affective space. The overall form of an object exhibits an intensity that is either strong or weak, which strongly corresponds with its power to arouse. The results can provide insights to designers on how to use different form elements to achieve the affective response requirement, as well as on how to use different composition features to create differences in the affective response displayed in the overall form while employing only one form element.

Keywords: Kansei/Affective Engineering, Feature Recognition, Basic Content Analysis

1. Introduction

The overall form of an object comprises form elements that are combined using composition features. In other words, overall form entails form elements and form composition. Form elements can be visualized as equipment parts and form composition features as an instruction manual that teaches designers how to apply form elements for creating an overall form. Therefore, form composition is extremely crucial and must not be overlooked. Many studies on affective response have found that people are able to judge the affection behind the form of an object by merely looking at the fundamental parts found in the overall form of the object [1, 2] and that different form elements are used to induce different affective responses [3, 4]. Russell [5] introduced the pleasure-arousal (P-A) affective space (hereinafter referred to as P-A affective space), which consists of Axes P (pleasure) and A (arousal); he believed that the space effectively explains human affections. Human eye movement studies have shown that, when people view images, their focus is not evenly distributed across the overall image; instead, they pay a disproportionate amount of affective response to features that stand out [6, 7, 8]. When people look at the form of an object, a two-stage observation method is employed. First, they have an impression of the overall form of the object. Next, they look at the details of the fundamental parts of the object and form judgments. However, if time is limited, viewers tend to judge the affection according to the form composition observed during the first-stage observation. Conversely, if time is sufficient, they judge the affection according to the form elements observed during the second-stage observation [6], which signifies that form composition is even more critical than form elements in delivering the affective response of objects. However, many studies on Kansei/affective engineering have focused on form elements; these studies have primarily investigated form elements that designers should use to induce a specific affective response in people. Conversely, studies on how form composition can be used to induce affective response have been scant. The effect of form composition on affective response is
independent from the effect of form elements on affective response. For example, for the three images in Fig. 1, despite the form elements being identical (i.e., all circles but in varying sizes), the overall form of the images is different because the composition features used to design the images were different; the three images thus engender completely different affective responses. Consequently, rather than using different form elements to achieve a required affective response, designers should instead use the same form element but adopt varying composition features. Although many aesthetic researchers have proposed that designers use form composition features [9,10,11], none has explained the affective response that these composition features were able to induce. In summary, studies on Kansei/affective engineering must determine the relationships between form composition features and affective response. Affective response has a profound effect on people’s minds and bodies, and form is a crucial factor of affective response. Therefore, understanding the relationships between form composition and affective response is beneficial to designing appropriate forms. This study thus employed a Semantic Differential (SD) survey, content analysis, and the P-A affective space to generalize four form composition features that correspond to people’s affective responses.

Figure 1. Distinct forms resulting from the same form element in various compositions

2. Literature

2.1 Dividing affective responses into Different Classifications in Kansei/Affective Engineering

Kansei engineering is a consumer-oriented product development technology proposed by Japanese scholar Nagamachi Mitsuo. It is defined as a “technology that converts a consumer’s feelings and image toward a product into design elements.” [12] In the past three decades, kansei engineering has expanded greatly and has become a significant discipline both in the industrial and the academic worlds. Levy[13] discussed kansei engineering development history and divided kansei research into three fields: KE( kansei engineering ), KS ( kansei science ) and KD ( kansei design ). KE( kansei engineering ) represents a meeting between kansei and engineering. [13]. The word " Kansei" is come from Japanese term, in recent years, "Kansei engineering" is often translated into English "affective engineering" [14], therefore, this study will translate "Kansei" as "affection ". In the field of psychology, affective response can be defined in various ways; it is most commonly defined as a multifaceted phenomenon with facets that can be used to understand people’s reactions toward various stimuli. Affective response is a measurable item and one of the most commonly used methods to measure affective response is the Semantic Differential (SD) evaluation, a subjective investigation method [2]. Chan [1] found that, once form elements crucial to the perception of style have been identified and a certain number of form elements have been combined together, viewers are able to perceive the forms and styles that designers are trying to convey. However, because people’s preferences in form and style are continually evolving trends, affective engineering remains a crucial topic in design studies. In 1980, Russell introduced the circumplex model of affect and the P-A affective space, in which affective response (i.e., Kansei) can be described by a affective space constructed from Axes P (pleasure) and A (arousal); he believed that the space effectively explains human affections. In addition, he proposed 28 basic affections in the circumplex model of affect and the distribution of these affections over the P-A affective space, as shown in Fig. 2. Pleasure represents positive and negative affections that people experience and are similar to the positive and negative valences introduced by Desmet [2].

Figure 2. Circumplex model of affect [5].

Arousal indicates the intensity of the affection evoked in people. Four basic affective response results can be generalized by using the four quadrants of the P-A affective space: pleasure and arousal, pleasure and sleepiness, displeasure and arousal, and displeasure and sleepiness. These four affective response results
comprise Russell’s circumplex model of affect. Expanding the circumplex model of affect, Yik, Russell, and Steiger [15] included more affections in the P-A affective space and indicated their distribution, which indicated that the model is an effective tool for dividing affective response into different categories.

2.2 Form Composition and Feature Recognition

Almost all form types can be explained and analyzed using form principles, which are the basic principles determining what constitutes “beauty” and include the use of form elements and their form composition. To analyze the various form compositions, which induce different affective responses, the basic form composition and elements governed by form principles must first be understood. Gothic believed that each piece of work has its own makeup; the makeup of a piece of work is commonly referred to as “composition.”

The term “composition” is not limited only to the visual arts; 2D (i.e., graphic) designs and 3D (i.e., product) designs are all composed of form elements [16]. Therefore, regardless of the design type (i.e., 2D or 3D designs), their form elements and composition are the essential factors influencing a viewer’s aesthetic judgment and determining the affective response displayed by the designs. Contemporary scholars of aesthetics have performed various analyses and reviews, dividing forms and form composition features into a number of categories. These categories can be used to express art objects and forms [9, 10, 11]. Feature recognition describes how humans encounter external objects, a process in which we perceive the forms of the objects and compare them with information stored in our memory before categorizing these objects. In cognitive psychology, form identification can only occur when two conditions are satisfied: a form induces external stimuli, and the external stimuli evoke the person’s previous knowledge and experience regarding the form. Valentine [11] proposed that even the characteristics and directions of lines are able to induce affective response. In their own way, these lines imitate the dynamics of affective response for example, vertical lines resemble people striving to improve, curved lines resemble people bent at the waist, and exploding lines resemble fireworks in the sky. We describe this type of affective response as transference. In a study on the effect of human factors on product design and development, Schmitt, Falk, Stiller, and Heinrichs [17] found that, when people purchase products, the most influential factors are product customization, affective value, and design, which indicates the importance of designers knowing the affective response induced by form designs when developing products. Cheng [18] showed that people are able to tolerate a certain degree of physical variation when identifying the form of an object. Reid, MacDonald, and Du [19] conducted a study in which product samples comprised those drawn using computer sketches and realistic rendering. An experiment regarding product form judgments was subsequently performed using an eye-tracking system; the results showed that, when judging product forms, subjects were unaffected by the method used to draw the images (i.e., computer sketch or realistic rendering) and that they used identical fundamental features found in the products as the basis for their judgments. Wang & Hsu [20] found that people generally require only two to three fundamental features to be able to recognize objects, revealing their superior form recognition ability. Regarding the overall process of form observation and recognition in humans, Buswell [6] indicated that, when looking at the form of an object, people generally observe the overall structure of the object and that they look at the details of the object (e.g., form elements and form features) only when time is sufficient. The visual trajectory of the subjects followed the form of the structure, which shows that, when people observe the form of an object, the composition features that govern the overall form of the object play a crucial role.

2.3 Affective Response -Inducing Abstract Forms

Compared with figurative forms and product forms, abstract forms are not restricted by external factors such as “functionality”; therefore, they are able to better express people’s explicit perceptions of affective response. Takahashi [4] used samples of abstract 2D forms to identify the form elements found in the different affective response -inducing abstract forms and explore the relationships between forms and affective responses. The experiment was divided into two stages: creation and perception. At the creation stage, seven words that described human qualities and affective responses (i.e., anger, joy, tranquility, depression, human energy, femininity, and illness) were selected for graphic design experts to create 21 corresponding abstract 2D images (Fig. 3). At the perception stage, another group of graphic design experts analyzed the forms of these images and deduced seven affection-related words, as well as the relationships between these words and the
respective forms (Table 1). Chuang, Hsu, and Fann [3] changed the seven affection words of Takahashi [4] to adjectives. Antonyms were added to these adjectives to form seven adjective pairs: 1. angry–calm, 2. joyful–sorrowful, 3. noisy–tranquil, 4. excited–depressed, 5. feminine–masculine, 6. energetic–idle, and 7. healthy–ill. Table 1 was provided to a group of graphic design experts as a reference before being asked to draw three images for each adjective pair, two of which were to depict the two adjectives and one of which was to illustrate the “median” affection. The 21 sample images, their number, and the respective affection are shown in Fig. 4.

Table 1. The specific visual elements of seven affective responses [4].

<table>
<thead>
<tr>
<th>Affective responses</th>
<th>Specific visual elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>angry</td>
<td>Jagged, pointed forms; repetition of lines; jagged texture; thick lines.</td>
</tr>
<tr>
<td>depression</td>
<td>Hatched lines filling the format; curving descending lines; thin lines.</td>
</tr>
<tr>
<td>human energy</td>
<td>An exploding image; rising triangular forms; repetition of lines; thick lines.</td>
</tr>
<tr>
<td>femininity</td>
<td>Curving lines; crossed forms; no apparent repetition; smooth texture; thin lines.</td>
</tr>
<tr>
<td>joy</td>
<td>Curving, circular forms; repetition of circles; rounded texture; thin lines.</td>
</tr>
<tr>
<td>tranquility</td>
<td>Horizontal lines; no repetition; smooth texture; thin lines.</td>
</tr>
<tr>
<td>illness</td>
<td>A form of one type superimposed on a form of another character; no repetition; smooth texture.</td>
</tr>
</tbody>
</table>

These images were subsequently used as stimuli, with subjects being asked to make a SD evaluation using the seven affections as scales. The evaluation results were combined with those of the expert questionnaires to induce the specific form elements of the 14 relative affections in the seven adjective groups. The study results also showed significant correlations between the form elements and the 14 relative affections. Although this study used abstract images to investigate affective responses and analyze forms, the focus of the analysis was solely on form elements, and the effect of form composition features was ignored. Therefore, the present study used the discussed results to further examine the effect of the affective response-inducing form composition features.

3. Methods

This study asked the subjects to make a SD evaluation of all the sample images. Subsequently, four graphic design experts were asked to divide the various compositions into items and categories according to study requirements. Next, they were requested to perform a content analysis of the form composition of the sample images.  

3.1 SD Evaluation of the Affection Displayed in the Samples

To further examine the effect of the affective response-inducing form composition features, this study used the 21 abstract images introduced by Chuang, Hsu, and Fann [3] as stimuli and asked the subjects to perform a affective evaluation of the samples by measuring the seven adjective groups (Fig. 4) using a 7-point Likert scale. During the evaluation, the samples appeared in random order. According to Nodine, Locher, and Krupinski [21] and Vogt and Magnussen[22],
participants trained in arts are more capable of identifying the relationship between the composition of an entire form and its elements. Because the objective of this study was to analyze the different affective response-inducing form structures, we selected 30 subjects (half male and half female, the average age is 25 years old) who had received basic design or art training more than 4 years. Although the participants understood both Mandarin and English, despite them preferring Mandarin, the affection word pairs were presented in both Mandarin and English on the questionnaire to ensure that the participants understood the precise meaning of the affection words. Every participant have 120-min to answer the SD questionnaire. To reduce fatigue, the participants took a 10-min break between every 30-min. A factor analysis of the survey data was used to derive the affective space and distribution of the adjectives and sample images in the affective space, which facilitated subsequent analysis and discussion.

3.2 Content Analysis of Form Composition of the Samples

Content analysis involves analyzing the hidden meanings of data using an objective, systematic, and quantitative method [23, 24]. For example, Thyme, Wiberg, Lundman, and Graneheim [25] applied content analysis in graphic research to examine images drawn by subjects receiving psychotherapy and the colors that they used to draw the images. The objective was to analyze the hidden messages in the subjects’ artwork from a psychological perspective to obtain information to facilitate psychotherapy. The study results confirmed that analyzing the hidden messages behind the drawings was highly useful. To analyze relationships between the form composition and affective response displayed by the samples, the form composition of the samples first had to be analyzed. This study had four industrial design experts (their professional backgrounds are provided in Table 2) engage in a discussion based on the study requirements to identify the items of composition features by using KJ method. The author of the study informed the experts regarding the objective of the experiment, explaining that the numerous form composition features had to be categorized to facilitate analyzing the content of the form composition. The four experts divided the composition features that created the overall form of objects into three items: explicit form (i.e., composition exterior), inherent characteristics of composition (i.e., composition type), and method of composition (i.e., composition manner). The items as used in the study are as follows: 1. Composition exterior: The explicit patterns displayed by the overall form (divided into seven categories); 2. Composition type: The inherent characteristics that make up the overall form (divided into six categories); and 3. Composition manner: The methods that make up the overall form (divided into four categories). Table 3 shows the three items and 17 categories. Through the questionnaire method, the four experts were asked to perform a content analysis of the form composition of the 21 samples (each of which possessed its own stimulus). Figure 5 shows the form composition analysis of Sample P19 (healthy) made by one of the experts. Of the 17 form composition features, Sample P19 exhibited a “dynamics” and “unity” composition exterior, “active” and “directional” composition type, and “explosive” composition manner.

Table 2. Backgrounds of the experts

<table>
<thead>
<tr>
<th>Expert</th>
<th>Male/Female</th>
<th>Profession</th>
<th>Experience</th>
<th>Specialty</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Male</td>
<td>Lecturer</td>
<td>6 years</td>
<td>Product design</td>
</tr>
<tr>
<td>2</td>
<td>Female</td>
<td>Lecturer</td>
<td>5 years</td>
<td>Graphic design</td>
</tr>
<tr>
<td>3</td>
<td>Female</td>
<td>Industrial designer</td>
<td>6 years</td>
<td>Product design</td>
</tr>
<tr>
<td>4</td>
<td>Male</td>
<td>Industrial designer</td>
<td>6 years</td>
<td>Product design</td>
</tr>
</tbody>
</table>

Table 3. Items Analyzed in Form Composition (As Compiled by This Study)

<table>
<thead>
<tr>
<th>Item</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Exterior</td>
<td>Dynamics, Unity</td>
</tr>
<tr>
<td>2. Type</td>
<td>Sparse, Concentrated, Active, Directional</td>
</tr>
<tr>
<td>3. Manner</td>
<td>Meandering and bending, Packing and cracking</td>
</tr>
</tbody>
</table>

Figure 5. Sample of form composition results.

The composition data of the 21 sample images were obtained through form composition analysis. Subsequently, by acquiring information regarding the distribution of samples in the P-A affective space and by grouping the samples using the four affective responses, the composition features governing the various forms were calculated and analyzed. Because four different experts performed the evaluations, mutual agreement
and reliability values were used to determine the reliability of their evaluations [26]. These two values were calculated using the following formulas [26]:

Formula 1. Mutual Agreement Statistic Formula:

\[ M = \frac{(I \times S) - N}{I \times S} \]

I: Number of Items. S: Number of Samples. N: items not agreed upon. M: Mutual agreement statistic.

Formula 2. Reliability R Value Formula:

\[ R = \frac{E \times M}{1 + (E-1)M} \]

E: Number of experts.

Kassarjian [28] argued that results with a reliability value greater than 85% could be accepted and those with a reliability value less than 80% should be questioned.

4. Results and Discussion

A factor analysis was performed on the data obtained from the SD evaluation to construct the affective space, which enabled us to learn about the distribution of the sample images in the affective space. In addition, the P-A affective space introduced by Russell [5] was used as a reference to obtain sample images distributed over the four quadrants of affective responses. From the results obtained by the graphic design experts through image content analyses and the relevant calculation percentages, the primary composition features of the sample images were obtained; the composition features were obtained by observing their locations (i.e., the quadrant occupied) in the P-A affective space.

4.1 SD Evaluation Results and Factor Analysis

A factor analysis was performed on the SD evaluation, and factors were extracted using principal component method. The maximum variance method was employed as a factor-shift method for deducing the two factors governing the seven adjective groups. The factor-loading situation is shown in Table 4. The factor-loading information was used to derive the affective space and determine the distribution of the 14 affections in the affective space (Fig. 6). Four affective responses (i.e., excited, calm, angry, and depressed) were found in the affective space, exhibiting a distribution almost identical to the manner in which the circumplex model of affect was distributed in the P-A affective space (adjectives shown in red boxes in Fig. 2); the four affective responses were also identical. Therefore, the P-A affective space and circumplex model of affect were used for analyzing the study results. The aforementioned analysis showed the affections located in each of the four quadrants: (a) The “pleasure, arousal” quadrant contained energetic, excited, joyful, and healthy; (b) The “displeasure, arousal” quadrant contained “noisy,” “angry,” and “masculine”; (c) The “pleasure, sleepiness” quadrant contained “tranquil,” “calm,” and “feminine”; and (d) The “displeasure, sleepiness” quadrant contained “sorrowful,” “ill,” “idle,” and “depressed” (Fig. 6). Because the adjective group “feminine–masculine” demonstrated low communalities during the factor analysis (0.444), they were excluded from subsequent discussions and analyses.

4.2 Representative Samples of the Four Affective Response Groups in the P-A Affective Space

A factor analysis produced factor scores for all of the sample images, which were then plotted in the form of a scatter plot in the affective space (Fig. 7). The distribution of the sample images in the affective space (Fig. 7) was similar to that of the circumplex model of affect in the P-A affective space. In particular, the locations of Sample Images P1 (angry), P4 (depression), and P3 (calm) in the affective space were almost identical to those in the P-A affective space (adjectives shown in red boxes in Fig. 2). Therefore, the P-A affective space was used to analyze and discuss the sample image results of this study. By determining the locations of the sample images in the P-A affective space and administering a SD survey to the subjects, we were able to observe that the affective responses experienced by the subjects after observing the sample images (i.e., images drawn by the graphic design experts using the seven adjective groups) were almost identical to the affective response that we attempted to display, indicating that the sample images used in this study effectively represented the target affective response. After naming the two axes (i.e., Axes P and A) of the affective space, the distribution of the sample images in the four quadrants (i.e., “pleasure, arousal,” “displeasure, arousal,” “pleasure, sleepiness,” and “displeasure, sleepiness”) was identified. To determine the affective responses types that evoked stronger feelings in the subjects and the types that featured forms that were more representative, the circumplex model of affec was adopted. A ring-like shape was drawn using factor scores as the radius and was given a value of 1. Sample images external to the ring (i.e., sample images found outside of the dotted circle shown in Fig. 7. Total 14 sample
images) were used as sample images representative of their respective quadrant, and a subsequent analysis was performed. This method identified sample images for the four quadrants: (a) “Pleasure, arousal”: P4 (excited), P7 (energetic), P10 (feminine), P13 (joyful), and P19 (healthy); (b) “Displeasure, arousal”: P1 (angry), P5 (excited-depression), P16 (noisy), and P20 (health-ill); (c) “Pleasure, sleepiness”: P3 (calm), P12 (masculine), and P18 (tranquil); and (d) “Displeasure, sleepiness”: P6 (depression), P9 (idle), and P21 (ill). The P-A affective space was used to divide these sample images into four different affective responses types. A content analysis was conducted to investigate the form composition of the four sample-image groups and determine the form composition characteristics of each group.

Table 4. The results of factor analysis

<table>
<thead>
<tr>
<th>Bipolar adjectives</th>
<th>Factor 1</th>
<th>Factor 2</th>
<th>Communality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy - Ill</td>
<td>0.971</td>
<td>-0.159</td>
<td>0.967</td>
</tr>
<tr>
<td>Joyful - Sorrowful</td>
<td>0.946</td>
<td>-0.283</td>
<td>0.975</td>
</tr>
<tr>
<td>Energetic - Idle</td>
<td>0.887</td>
<td>0.434</td>
<td>0.976</td>
</tr>
<tr>
<td>Excited - Depression</td>
<td>0.832</td>
<td>0.453</td>
<td>0.897</td>
</tr>
<tr>
<td>Feminine - Masculine</td>
<td>0.585</td>
<td>-0.318</td>
<td>0.444</td>
</tr>
<tr>
<td>Noisy - Tranquil</td>
<td>0.133</td>
<td>0.964</td>
<td>0.947</td>
</tr>
<tr>
<td>Angry - Calm</td>
<td>-0.275</td>
<td>0.936</td>
<td>0.952</td>
</tr>
</tbody>
</table>

Eigenvalues                     | 3.752    | 2.406    |
Variance %                      | 53.593   | 34.378   |
Cumulative variance %           | 53.593   | 87.971   |

Analysis

Regarding the form-composition content analysis survey, the four experts were asked to fill in a value of 1 for categories that were effectively displayed by the 14 sample images (e.g., for the item of “composition exterior,” the categories were dynamics, symmetry, contrast, equilibration, proportion, harmony, and unity) and a value of 0 if otherwise. The categories with a value of 0 were removed, and the “match percentage” (i.e., the percentage of sample images that effectively displayed the category) was calculated. A match percentage greater than 50% signified that the category was representative of the form composition features for that respective quadrant. Equations 1 and 2 were used to calculate whether the results achieved reliability and produced a mutual agreement value of 0.94 and a reliability value of 0.98, both of which exceeded the standard value of 85% (0.85).

Fig. 7. Distribution of the 21 sample images in the Pleasure - Arousal (P-A) affective space.

4.3 Results of the Form Composition Content

4.3.1 Form Composition Features for the “Pleasure, Arousal” Group

Sample images that represented the “pleasure, arousal” group were P4 (excited), P7 (energetic), P10 (feminine), P13 (joyful), and P19 (healthy), as shown in Fig. 7. After the content analysis results (measured in percentages) were calculated, the categories most representative of the form composition features in this quadrant were identified. The most common composition exterior characteristics were “dynamics” (100%) and “unity” (80%). “Active” was the most common composition type (100%, observed in all of the sample images). “Explosive” was the most prevalent...
composition manner (100%, identified in all of the sample images). In this quadrant, the affection felt most strongly by the subjects were “energetic,” “excited,” and “noisy” (Fig. 6).

4.3.2 Form Composition Features for the “Displeasure, Arousal” Group

Sample images that represented the “displeasure, arousal” group were P1 (angry), P5 (excited-depression.), P16 (noisy), and P20 (healthy-ill), as shown in Fig. 7. After the content analysis results (measured in percentages) were calculated, the categories most representative of the form composition features in this quadrant were found. The most common composition exterior characteristics were “unity” (100%) and “dynamics” (75%). “Concentrated” (100%) and “active” (100%) were the most common composition types. “Packing and cracking” was the most prevalent composition manner (100%). In this quadrant, the affection felt most strongly by the subjects were “noisy” and “angry” (Fig. 6).

4.3.3 Form Composition Features for the “Pleasure, Sleepiness” Group

Sample images that represented the “pleasure, sleepiness” group were P3 (calm), P12 (masculine), and P18 (tranquil). After the content analysis results (measured in percentages) were calculated, the categories most representative of the form composition features in this quadrant were found. The most common composition exterior characteristics were “harmony” (100%) and “equilibrated” (67%). “Sparse” was the most common composition type (100%). “Balanced” was the most prevalent composition manner (100%). In this quadrant, the affection felt most strongly by the subjects were “tranquil” and “calm” (Fig. 6).

4.3.4 Form Composition Features for the “Displeasure, Sleepiness” Group

Sample images that represented the “displeasure, sleepiness” group were P4 (depression), P9 (idle), and P21(ill), as shown in Fig. 7. After the content analysis results (measured in percentages) were calculated, the categories most representative of the form composition features in this quadrant were found. The most common composition exterior characteristics were “unity” (100%) and “dynamics” (67%). “Concentrated” (100%) was the most common composition type (100%). “Packing and cracking” (100%) and “meandering and bending” (67%) were the most prevalent composition manners. In this quadrant, the affection felt most strongly by the subjects were “sorrowful,” “ill,” “idle,” and “depressed” (Fig. 6).

4.4 Discussion

By summarizing the characteristics obtained from the analysis of the four groups, the form composition features represented by the four quadrants in the P-A affective space were identified; the results are shown in Fig. 8. The form-composition analysis results acquired using form identification theories showed that these results are highly related to people’s life experiences. Because people’s daily experiences with forms accumulate over time, they perceive varying form compositions as having different affective responses. When faced with form compositions, people instinctively classify them into different categories and judge the affection according to their perceptions. Comparisons between the categories found on Axis P (pleasure–displeasure) showed that objects that feature a unity composition exterior, concentrated composition type, and packing and cracking composition manner generate a sense of displeasure in people regardless of the level of arousal or sleepiness. Conversely, comparisons between the categories found on Axis A (arousal–sleepiness) showed that objects featuring a unity composition exterior and active composition type foster a sense of arousal in people regardless of the level of pleasure or displeasure, which indicates that form compositions possess strong or weak intensity, as well as strong or weak “arousal ability,” and that a significant complementary relationship exists between them. Form principles and transference were used to explain these observations; a unity composition exterior signifies that the images contain an overall form that is highly consistent, suggesting that the object form is based on a theme. The complementary relationship between “domination” and “subordination” creates a sense of “authoritativeness” or “power” in the object form. An active composition type means that the forms are strongly influenced by an external force, which engenders a sense of instability or power. A concentrated composition type that is packing and cracking implies that the form elements of the images sustain an oppressive force[11] and that such a form, when highly intense, evokes a sense of “discomfort and having to withstand pressure.” When observers perceive strong intensity in the form of an object, they are more likely to think of highly arousing affection such as “noisy” and “angry.” Conversely, when observers experience low intensity in the form of an object, they are more likely to
think of minimally arousing affection such as “sorrowful,” “ill,” “idle,” and “depressed.” Comparisons between the form composition of the “pleasure, arousal” and “pleasure, sleepiness” quadrants show an opposing relationship between a dynamics composition exterior and a harmony composition exterior. This opposition results from the harmony composition exterior being constructed of elements that are in harmony, producing a weaker external force and engendering a sense of stillness (i.e., affection such as “tranquil” and “calm”). By contrast, a dynamics composition exterior features a sense of power. Comparisons between the form composition of the “displeasure, arousal” and “displeasure, sleepiness” quadrants indicated that, contrary to sample images from the “arousal” groups, those from the “sleepiness” group did not all show an active composition type. These results showed that the intensity displayed in the overall form of an object could effectively influence the subjects’ feeling toward its form, as well as create a different level of arousal and that the stronger the feeling was, the higher the level of the arousal. Conversely, the weaker the subjects’ feeling was toward the object form, the lower the level of arousal.

5. Conclusion

This study found the form composition features of the sample images after dividing the sample images into different groups by using the P-A affective space introduced by Russell[5]; these sample images were placed in the four different quadrants of the P-A affective space. The results of the affective response of form composition were generalized into four features that governed form composition in the P-A affective space: (a) The “pleasure and arousal” dimension features a relatively “dynamics” composition exterior, “active” composition type, and “explosive” composition manner, causing people to feel energetic, excited, joyful, and healthy; (b) the “displeasure and arousal” dimension features a relatively “unity” composition exterior, “concentrated” composition type, and “packing and cracking” composition manner, causing people to feel noisy and angry; (c) the “pleasure and sleepiness” dimension features a mostly “harmony” composition exterior, “sparse” composition type, and balanced composition manner, causing people to feel tranquil and calm; and (d) the “displeasure and sleepiness” dimension features a “unity” composition exterior, “concentrated” composition type, and “packing and cracking” composition manner, causing people to feel sorrowful, ill, idle, and depressed. Form compositions possess strong or weak intensity and strong or weak arousal ability; a significant complementary relationship exists between them. The stronger the intensity that observers feel in the overall form of an object is, the higher the level of arousal. Conversely, the weaker the intensity that observers feel in the overall form of an object is, the lower the level of arousal. This study identified the form composition of the affective responses found in the four quadrants of the P-A affective space, as well as their respective form composition features. Designers can convey different affective responses through their form designs by referring to these features. However, the goal of the study results was not to limit the design freedom of designers but to provide them with simple and logical design information that could be used as a reference. Regarding how the study results can be applied in practice, designers can now change form elements and alter the form composition features to change observers’ affection. For example, the four different affections types introduced in this study may be combined with the study results of Chan[1] or Takahashi[4], through which designers can enhance the affective response the people experience by increasing, decreasing, or changing the form elements. In addition, designers can retain the same form element but change its form composition features to change observers’ affective response. This study offers the following contributions: (a) provides insights to designers on how form composition features and form elements can be used to accurately design forms that exhibit the desired affective features and on how to create differences in the affective response displayed in the overall form by using different composition features while employing only one form element; (b) allows designers to control form composition and form changes in a more logical manner when encountering different affective response requirements; and (c) enables subsequent researchers to use the experimental designs of this study as a reference to study the relative relationships between form and affective response.

6. References


