Association Between Facial Expressions and Symbolic Expressions of Emotion

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Abstract: This study proposed to investigate the effect of different educations in the cognition of facial expressions and symbolic expressions of emotion. Four hundred students with different genders from four departments were recruited in this study. The results suggested some facial expressions could be perceived differently because of different gender or educational background. The most important difference between facial expressions and symbolic expressions of emotion is that facial expression is more imitated and more accurately deliver the real mind states. However, the symbolic expressions of emotion are more stereotypic and hard to represent the details of a facial expression.

Key-Words: facial expressions, Symbolic expression of emotion, Abstract image.

1 Introduction
1.1 Research motivation
It is hard to image existence of art without emotions, because the art is born for emotional expressions. Often, the emotional reaction from arts is linked with preference of arts. Besides, the emotional reaction is related with the artists’ creation and application.

Most researchers have tried to represent facial expressions through abstract images, such as smile “😊” and sad “😢”. The same curve with opposite direction represents different facial expressions of emotion. Meanwhile, many symbols related with emotion are in daily life, such as emotional magnets (different emotions can be recorded on), emotional climate representing climate change, symbolic emotions of online messenger, and emotional sticks. These symbols are produced with simplified figures to represent various expressions of emotion.

Studies of emotions are often seen in anthropology, culturology, psychology, biology; however, less interest in arts and designs. Thus, this study proposed to explore the cognition of emotional reaction to facial expressions and symbolic expressions of emotion which are used on internet. The results in this study could be a reference for those experts who are in the fields of performance, arts, and design.

1.1 Research aims
1) To explore the relationship between educational backgrounds, gender and interpretation of facial expressions.
2) To explore the relationship between educational backgrounds, gender and interpretation of symbolic expressions of emotion.
3) To compare the differences of the cognition of facial expressions and symbolic expressions between different educational backgrounds, genders.

2 Literature review
2.1 Nature of emotional reaction — representative images of emotion
Facial expressions are the most direct emotional representations and recognized universally. Previous studies suggested that since children can judge other
people’s emotions by looking at their facial expressions \cite{Durand, Gallay, Seigneuric, Robichon, Baudouin, 2007}. In addition, Izard \cite{Izard, 1977} suggested that the facial expression is the constructive patterns on the facial reaction which is innate. This supports that the universality of facial expressions is innate induced by neural formula \cite{Ekman, 1992}. Ekman \cite{Ekman, 1992} emphasized the importance of facial expressions and suggested once change a person’s facial expression the mind status can be changed as well. In addition, he suggested that the language is not sufficient to explain emotions \cite{Suveg, Zeman, 2004}. Suveg and Zeman \cite{Suveg, Zeman, 2004} further suggested that the expressions of emotion often is independent of language, and can be judged \cite{Izard, 1991}; however, Izard \cite{Izard, 1991} addressed that the audiences can be misguided by the false expressions \cite{Izard, 1991}.

2.2 Abstract figures
An abstract figure is not only the appearance that we perceive an object in our perceptual system, but also the influence by our perception. Because of the induction of physical and psychological status by schematic outline, all elements are filled with various emotions. Bell \cite{Bell, 1989} suggested that a line can indicate the relationship between two objects and also show the direction, space movement and emotions. For example, happiness or sadness can be represented by a line with different direction \cite{Bell, 1989}. Additionally, several studies have investigated the representation that a line with different direction shows different expression of emotion. For instance, for positive emotions, happiness, enjoyment, the line direction is upper; for negative emotions, sadness, upset, the direction is shown down; for the emotions, anger, the line is shown with various directions; for painful and uneasy, the representative line is scraggly \cite{Lin, 1999}. Therefore, the perception of a form (line, dots and surface) can be different based on the different movement or appearances. In addition, it can be affected on the basis of the people’s inner feelings.

2.3 Studies of facial expressions and abstract figures
Liu \cite{Liu, 2008} suggested that the perception of the expressions of emotion, surprise and horrify is different among those students with different educational backgrounds \cite{Liu, 2008}. Earlier, Liu \cite{Liu, 2005} found that the relationship between different voices and symbols is similar among those students with different backgrounds, except those who received expert training (e.g., students in department of design) \cite{Liu, 2005}. This supported the previous study in which all students recruited in the study showed similar perception of those schematic drawings \cite{Edwards, 1986}.

Moreover, not only educational backgrounds, but also gender difference play different role in perception of emotions. Because of gender stereotypes, people with different genders may have different perception on facial expressions. Shaffer \cite{Shaffer, 1999} suggested that the gender stereotype has been developed since a child who is at 2.5 years old \cite{Mead, 1934}. However, earlier, Mead \cite{Mead, 1934} suggested that the gender stereotype is developed on the basis of social culture \cite{Mead, 1934}.

3 Research method
3.1 Research participants
400 students, 100 in each (age range from 20-25 years old) from four departments (College of Literature, Science, Management and Design) were recruited. Each participant has been received professional training for at least two years before participating in this study. All students were in their junior or senior year.

3.2 Research limitation
Because of various variables were investigated, several limitations were addressed below.
(1) Because facial expressions were the major issue in this study, eyebrows, eyes, and mouth were studied, but the muscle tension was not taken into concern.
(2) In order to remove those factors that may confound the results, tears, glasses and gestures were removed when the pictures were taken.
(3) Only the degrees of those faces post under 30 degrees were included, and the illumination was also taken into concern.
(4) Although too many abstract images, only those symbolic images representing facial expression were included.
(5) Due to uncertain usage of those icons from internet and messengers, the authors used KJ module to re-characterize and re-draw the symbolic images.

3.3 Research materials
3.3.1 Facial expressions
Totally sixteen photographs of facial expressions were selected from foreign movies. Each photograph was modified with black and white and measured 5 x 5 cm (Figure 1)
3.3.2 Geometric Images
All symbolic facial expressions were drawn from Internet and the author. Eleven images were then selected in this study and each image was measured 1.5 x 1.5 cm (Figure 2).

3.3.3 Variables of Emotional Adjectives
120 undergraduates were recruited to find and categorize emotional adjectives which are used mostly in daily life. Each student was assigned to one group according to KJ group method, and was required to write three commonly used emotional adjectives on a card. Totally, 360 cards were collected. Subsequently, four researchers reviewed all cards and categorized all adjectives into some categories based on word meaning and similarities. The researchers gave a name for each category. For those adjectives could not be categorized were excluded. Finally, twenty four adjectives were selected as follow: astonished, fearful, cheerful, scared, joyful, excited, wrathful, inspired, hateful, sad, worried, angry, offended, shy, painful, fidgety, nervous, frightened, disgusted, happy, panic, surprised, upset, and terrified.

4 Results
Totally 400 students from different colleges (100 in each college) were recruited in this study to investigate the influence of gender and educational backgrounds in processing facial expressions. Each college student has been given professional training for at least 2 years. All participants were on their junior or senior of college when they were drawn.

Each participant received two sections of task, perception of facial expressions, and geometric images representing emotional expressions. For each image, 24 items of emotional adjectives were given, and participants were required to give the top three choices.

Chi-square tests were run and showed significant different distribution between different genders and educational backgrounds ($\chi^2 = 49.8$, $p < .01$).

4.1 Cognition of emotional reaction to facial expressions
The results showed that the most chosen adjectives for the photograph labeled A1, A7, and A11 (Figure 1) were similar. The data shown in Table 1, the adjectives, ‘scared, astonished and terrified’ were chosen by most of students, indicating that these three adjectives better to describe the emotion of A1, A7 and A11. Moreover, we analyzed the characters of image A1, A7 and A11 (Figure 1) and found that there is an obvious character on both images which is that both images contain opened-eyes and slightly opened-mouth (did not consider whether the emotion is positive or negative). This character is sometimes used to describe a surprised face. In addition, image A7 does not only contain that character mentioned above, but also contains more exaggerative expression. Therefore, the facial expression of image A7 could be more salient than others. The ranking order of cognition of emotional reaction are shown in Table 1.

In addition, chi-square tests were further carried to investigate in which image, the association between gender and educational backgrounds could be found. The results showed that for image A1, significant differences for the adjectives, ‘scared’ ($\chi^2 = 35.6$, $p < .01$) were found. However, these significances were not found for image A7 and A11. In table 2, the proportion in each adjective showed that for ‘scared’, 105 males and 191 females; for ‘terrified’, 79 males and 143 females. The data showed a significant difference that cognition of
facial expression was affected by genders. Moreover, the analyses between different educational backgrounds were carried. The results showed that for image A1 and A7, the adjective, ‘scared’ ($\chi^2 = 24.1, p < .01$; $\chi^2 = 27.1, p < .01$), and ‘terrified’ ($\chi^2 = 16.2, p < .01$; $\chi^2 = 26.3, p < .01$) were significantly different. For image A11, the significant differences were found as follow: for ‘scared’, $\chi^2 = 14.3, p < .01$; for ‘astonished’, $\chi^2 = 13.7, p < .01$. The results showed that the adjective ‘scared’ was found for three images, suggesting that the cognition of the expression ‘scared’ might be affected by different education. Furthermore, the highest difference was found within the students from College of Science.

**Table 2. The top three adjectives for each image**

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<th>number</th>
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<tbody>
<tr>
<td>A1</td>
<td>scared</td>
<td>astonished</td>
<td>terrified</td>
</tr>
<tr>
<td>A7</td>
<td>scared</td>
<td>terrified</td>
<td>excited</td>
</tr>
<tr>
<td>A11</td>
<td>astonished</td>
<td>scared</td>
<td>nervous</td>
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</table>

The results showed that the adjectives, wrathful, angry and offended were the top three choices for the images A2, A3, and A5 (figure 1) (Table 2). In addition, the similarities between the images A2, A3, and A5 are that they all have upper eyebrows, opened-eyes and mouth. Although in the image A5, the face represents wrathfully, the mouth is closed, is not as strong as that in the images A2 and A3.

Chi-square tests were conducted to compare the distribution for each image between different genders. For A2, the adjective, angry $\chi^2=10.3 \cdot p < .00$; for offended, $\chi^2=4.7 \cdot p < .03$. But, no significances were found either for A3 and A5, the adjective, angry (77 males, 133 females), and offended (80 males, 125 females). For educational background influences, for A2, the adjective, wrathful ($\chi^2=28.6 \cdot p < .00$); For angry ($\chi^2=10.0 \cdot p < .02$). For A3, the adjectives, wrathful ($\chi^2=8.3 \cdot p < .04$), for A5, the adjective, angry ($\chi^2=15.8 \cdot p < .00$), wrathful ($\chi^2=10.8 \cdot p < .01$) were found to be significantly different distributio.

**Table 2. The top three adjectives for each image**

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<th>number</th>
<th>1</th>
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<tbody>
<tr>
<td>A2</td>
<td>wrathful</td>
<td>angry</td>
<td>offended</td>
</tr>
<tr>
<td>A3</td>
<td>angry</td>
<td>wrathful</td>
<td>offended</td>
</tr>
<tr>
<td>A5</td>
<td>angry</td>
<td>hateful</td>
<td>disgusted</td>
</tr>
</tbody>
</table>

The results showed that the images A4, 8, 13, and 15 (figure 1) (Table 3) were received the similar judgments, sad, painful and upset. In the images A4, A8, A13 and A15, the similarities are frown eyebrows, closed-eyes and the head is slightly descending. Although for the images A4 and A15, both represent sad, the eyes in the image A15, the mouth is slightly opened and the head is slightly descending, the whole face is tight. The degree of sad in the A15 is more arousal than in the A4.

In addition, the chi-square analyses showed that for gender differences, for A4, the adjective, worried ($\chi^2=5.2 \cdot p < .02$); for A8, the adjective, sad ($\chi^2=3.9 \cdot p < .05$); for A13, the adjective, sad ($\chi^2=14.0 \cdot p < .00$), upset ($\chi^2=8.4 \cdot p < .00$), and painful ($\chi^2=5.1 \cdot p < .02$). For A15, the adjectives, painful ($\chi^2=4.1 \cdot p < .04$), and upset ($\chi^2=4.2 \cdot p < .04$) were found to be significant.

Moreover, for the analysis among different educational backgrounds, for A4, the adjectives, sad ($\chi^2=11.3 \cdot p < .01$), upset ($\chi^2=18.0 \cdot p < .00$) and worried ($\chi^2=11.8 \cdot p < .01$); for A8, the adjectives upset ($\chi^2=19.1 \cdot p < .00$); For A13, the adjectives upset ($\chi^2=19.6 \cdot p < .00$), painful ($\chi^2=12.2 \cdot p < .01$); For A15, the adjectives sad ($\chi^2=8.5 \cdot p < .04$) were found to be differentially distribut.

**Table 3. The top three adjectives for each image**

<table>
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<tr>
<th>Number</th>
<th>1</th>
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<tbody>
<tr>
<td>A4</td>
<td>sad</td>
<td>upset</td>
<td>worried</td>
</tr>
<tr>
<td>A8</td>
<td>sad</td>
<td>upset</td>
<td>worried</td>
</tr>
<tr>
<td>A13</td>
<td>sad</td>
<td>upset</td>
<td>worried</td>
</tr>
<tr>
<td>A15</td>
<td>painful</td>
<td>upset</td>
<td>sad</td>
</tr>
</tbody>
</table>

The results showed that the top three chosen adjectives were similar among the images A6, A9, A10, A12 and A16 (figure 1) (table 4). In addition, the most of participants chose the adjectives, cheerful, happy, joyful and surprise indicating that these adjectives were more likely to describe those facial expressions, labelled A6, 9, 10, 12, and 16. Because in the images A9, A10 and A16, the faces showed opened-eyes, upper eyebrows, slightly oepend-mouth and the whole face was more excited. For the image A6, the whole face was more relax with slightly opened-eyes and mouth. For the image A16, the head was slightly descending representing more smooth. These figures are more likely to represent happy, joyful and cheerful expressions of emotion.

In addition, Chi-square tests were run to compare the cognition of expressions between different genders for each image as follows: for A6, the adjectives, cheerful ($\chi^2=5.7 \cdot p < .02$); happy ($\chi^2=4.1 \cdot p < .04$); for A9, the adjectives, happy ($\chi^2=12.8 \cdot p < .00$); for A10, the adjective, surprise ($\chi^2=5.6 \cdot p < .02$), the significant difference was found between different genders.

Moreover, comparing the differences among different educational backgrounds, the significances
were as follows: for A6, the adjectives, cheerful ($\chi^2 = 14.1 \cdot p < .00$), happy ($\chi^2 = 18.5 \cdot p < .00$), joyful ($\chi^2 = 14.5 \cdot p < .00$); For A9, the adjectives, happy ($\chi^2 = 21.9 \cdot p < .00$), cheerful ($\chi^2 = 15.6 \cdot p < .00$), joyful ($\chi^2 = 10.0 \cdot p < .02$); For A10, the adjectives, surprise ($\chi^2 = 11.2 \cdot p < .01$), happy ($\chi^2 = 17.0 \cdot p < .00$), excited ($\chi^2 = 8.6 \cdot p < .04$); for A12, the adjectives, joyful ($\chi^2 = 13.4 \cdot p < .00$), happy, ($\chi^2 = 10.3 \cdot p < .02$), excited ($\chi^2 = 24.3 \cdot p < .00$).

Table 5. The top three adjectives for each image

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<th>Number</th>
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<tbody>
<tr>
<td>A6</td>
<td>cheerful</td>
<td>happy</td>
<td>joyful</td>
</tr>
<tr>
<td>A9</td>
<td>happy</td>
<td>cheerful</td>
<td>joyful</td>
</tr>
<tr>
<td>A10</td>
<td>surprise</td>
<td>happy</td>
<td>excited</td>
</tr>
<tr>
<td>A12</td>
<td>joyful</td>
<td>happy</td>
<td>excited</td>
</tr>
<tr>
<td>A16</td>
<td>happy</td>
<td>cheerful</td>
<td>shy</td>
</tr>
</tbody>
</table>

4.2 The cognition of symbolic facial

The results showed that the adjectives, wrathful, angry and offended were the most appropriate judgments for the pictures. The images B1 and B4 (figure 2) (Table 5), opened-eyes, upper eyebrows, and opened-mouth are the characteristics of both images, indicating angry and wrathful.

In addition, chi-square tests showed significant differences as follows: for B1, the adjective, angry ($\chi^2 = 8.1 \cdot p < .00$); For B4, the adjective, angry ($\chi^2 = 4.3 \cdot p < .04$). The data indicated that the cognition of an angry symbols could be affected by gender. Moreover, chi-square tests were run for comparing whether the cognition for each image is significant different among different educational backgrounds, and showed significant differences as follows: for B1, the adjective, angry ($\chi^2 = 7.9 \cdot p < .04$), and wrathful ($\chi^2 = 9.1 \cdot p < .03$); For B4, the adjective, excited ($\chi^2 = 22.4 \cdot p < .00$).

Table 5. The top three adjectives for each image

<table>
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<th>Number</th>
<th>1</th>
<th>2</th>
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<tbody>
<tr>
<td>B1</td>
<td>angry</td>
<td>wrathful</td>
<td>offended</td>
</tr>
<tr>
<td>B4</td>
<td>angry</td>
<td>excited</td>
<td>offended</td>
</tr>
</tbody>
</table>

The results indicated that the adjectives, worried and fidgety are the most appropriate adjectives for these figures (Table 6). The image B2 (figure 2) contains upward eyebrows and eye gaze and waved mouth which is more smooth. The image B7 contains upward eyebrows, opened-eyes and mouth. The image B10 contains downward curved eyebrows and mouth, representing sad.

Further, chi-square tests showed the significances for gender are as follows: for the image B2, the adjective, worried ($\chi^2 = 23.1 \cdot p < .00$); for the image B7, the adjectives, fidgety ($\chi^2 = 7.5 \cdot p < .00$) and offended ($\chi^2 = 18.5 \cdot p < .00$); for the image B10, the adjective, sad ($\chi^2 = 6.8 \cdot p < .00$). In addition, chi-square tests showed the significances for educational backgrounds are as follows: for the image B2, the adjectives, fidgety ($\chi^2 = 13.0 \cdot p < .00$) and sad ($\chi^2 = 12.8 \cdot p < .00$); for the image B7, the adjective, fidgety ($\chi^2 = 20.5 \cdot p < .00$); For the image B10, the adjective, sad ($\chi^2 = 6.8 \cdot p < .00$). The adjective, fidgety was found to be affected by different educations.

Table 6. The top three adjectives for each image

<table>
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<th>Number</th>
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<th>3</th>
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</thead>
<tbody>
<tr>
<td>B2</td>
<td>worried</td>
<td>fidgety</td>
<td>sad</td>
</tr>
<tr>
<td>B7</td>
<td>worried</td>
<td>nervous</td>
<td>fidgety</td>
</tr>
<tr>
<td>B10</td>
<td>sad</td>
<td>upset</td>
<td>worried</td>
</tr>
</tbody>
</table>

The results of indicating that image B3, 5, 6 and 9 (figure 2) (Table 7) received similar emotional cognition. The adjectives, happy, joyful and cheerful were the most appropriate adjectives for the images B3, 5, 6 and 9. For the images B5 and B6, the mouths are both slightly opened, and the eyes in image B5 are opened but closed in image B6. For the images B3 and B9, the eyes are opened with upward curved mouth, indicating joyful.

Further, chi-square tests showed the significances for gender are as follows: for B3, the adjective, cheerful ($\chi^2 = 8.0 \cdot p < .00$); For B5, the adjective, joyful ($\chi^2 = 7.8 \cdot p < .00$), excited ($\chi^2 = 18.5 \cdot p < .00$); For B6, the adjective, happy ($\chi^2 = 26.1 \cdot p < .00$); For B9, the adjective, happy ($\chi^2 = 14.3 \cdot p < .00$).

The significances for educational backgrounds are as follows: for B3, the adjective, joyful ($\chi^2 = 8.1 \cdot p < .04$), happy ($\chi^2 = 26.4 \cdot p < .00$) and cheerful ($\chi^2 = 10.4 \cdot p < .02$); For B5, the adjective, happy ($\chi^2 = 30.2 \cdot p < .00$), excited ($\chi^2 = 12.7 \cdot p < .00$); For B6, the adjectives, happy ($\chi^2 = 19.2 \cdot p < .00$), joyful ($\chi^2 = 11.3 \cdot p < .01$); For B9, the adjectives, shy ($\chi^2 = 10.5 \cdot p < .02$).

Table 7. The top three adjectives for each image

<table>
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<th>Number</th>
<th>1</th>
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<th>3</th>
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</thead>
<tbody>
<tr>
<td>B3</td>
<td>cheerful</td>
<td>happy</td>
<td>joyful</td>
</tr>
<tr>
<td>B5</td>
<td>joyful</td>
<td>happy</td>
<td>excited</td>
</tr>
<tr>
<td>B6</td>
<td>happy</td>
<td>joyful</td>
<td>cheerful</td>
</tr>
<tr>
<td>B9</td>
<td>shy</td>
<td>happy</td>
<td>cheerful</td>
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</tbody>
</table>
surprised' showing that image B8 was tended to be induced by accidental stimuli. For image B11, the rank order was 'nervous, frightened and panic', showing that B11 was tended to induce emotions, panic and horrified. In image B8 and B11, both images had opened-eyes; however, image B8 had an opened-mouth, and image B11 had a closed-mouth. Thus, image B8 had more similarities as did image A1 and A11, namely, more surprised. Nevertheless, image B11 did not have this characteristic.

Furthermore, chi-square tests were carried out to investigate that whether gender was a factor which influenced judgments of adjectives. The significant differences were found as follow: for image B8, gender significance was found for the adjective ‘scared’ ($\chi^2 = 5.0, p < .05$); for image B11, gender difference was found for the adjectives, ‘nervous’ ($\chi^2 = 7.4, p < .01$), ‘frightened’ ($\chi^2 = 5.3, p < .05$), and ‘panic’ ($\chi^2 = 14.8, p < .01$). For the analysis of educational differences, the significant differences were found as follow: for image B8, ‘scared’, $\chi^2 = 14.7, p < .01$; for image B11, ‘nervous’, $\chi^2 = 8.1, p < .05$; ‘frightened’, $\chi^2 = 22.9, p < .01$. The results showed that the cognition of adjectives, ‘scared, nervous, and frightened’ was different between different groups of educational backgrounds.

The data in Table 8 showed that the adjective, ‘surprise’ was different from other adjectives (e.g., scared, nervous, frightened and panic), because surprise is on the positive dimension of emotions. However, the adjectives, scared, frightened and panic are on the negative dimension of emotions.

Table 8. The top three adjectives for each image

<table>
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<th>Number</th>
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<th>3</th>
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<tbody>
<tr>
<td>B8</td>
<td>astonished</td>
<td>scared</td>
<td>surprised</td>
</tr>
<tr>
<td>B11</td>
<td>nervous</td>
<td>terrified</td>
<td>horrified</td>
</tr>
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</table>

5 Conclusion
The reason why a facial expression is represented is because of multiple organs, such as eyes, eyebrows, nose, mouth and muscle tension. However, it may be hard for a symbolic face to display emotion only based on eyes, eyebrows and mouth. The difference between facial expressions and geometric faces is that the real facial expression is more imitated than a symbolic face. It could be difficult to present a symbolic facial expression in more details as in a real facial expression. Several findings in this study are described as follows:

1. The face with opened-eyes, mouth (related with muscle tension) could represent astonished, scared and wrathful.
2. The face slightly descending with furrow eyebrows, slightly closed-eyes and downward curved mouth could represent sad.
3. The face with slightly opened-eyes, upward curved mouth (related with muscle tension) could represent cheerful, happy, and joyful. For the surprised face, the eyes play important role.
4. When the degree of the upper curve, the face represents happier, and the bigger opened-mouth represents more cheerful. However, when the mouth shown downward curved represents sad. The face with downward curved mouth is combined with opened-eyes represents wrathful.

References: