DESIGN OF A CHARACTER'S NEGATIVE PERSONALITY
AND RECOGNITION OF FACIAL PROFILE

Regina W.Y. WANG*, Mu Chien CHOU**, Tzu Huai YANG*, Chun Cheng HSU***

* National Taiwan University of Science and Technology, Graduate School of Design, Taiwan
** Chungyu Institute of Technology, Department of Digital Media Design, Taiwan
*** National Chiao Tung University, Department of Communication and Technology, Taiwan

Abstract: The design method of a character personality generally depends on the individual experience and the aesthetic accomplishment of the designer. This paper outlines the tendencies of a character personality design based on the analysis of 3D animation characters. Furthermore, this paper investigates the audience's cognition of character personality through a questionnaire. At the same time, the design features of a character personality are transformed into a concrete learnable mode and profile identity, thereby matching with the role character. In PIXAR movie animations, the face profile design of a negative character is inclined to be narrow and triangular. Moreover, the proportions of various facial features, such as the mouth and teeth, play an important role in the molding of the negative character, as observed in this study. The methods and procedures used in this study can be applied in the 2D emblem design of the character identity of both corporate and graphic characters (e.g., cartoons and dolls).

Keywords: PIXAR, Character Personality, Pattern Recognition, Graphic Character

I. Foreword

1.1. Background and Motives of this Study

Character design is usually dependent on the individual artist's experience and his or her aesthetic accomplishment, sometimes with little understanding of the character's personality features and subsequently less accuracy in portraying them[1,2].

Since the production of Toy Story by PIXAR in 1995, they have often preferred much more realistic personate cartoon effect on the design of the cartoon figure modeling. However, it is a complex process to endow the cartoon figure personate features[3]. Diamond and Carey (1986)[4] put forward with the second-order relational properties on the character personality so as to illustrate the array of positions and angles as well as the figure facial profile on which the relational angle could be formed by the vertical, horizontal, and relational lines. This will result to the change of the figure appearance and personality, which will make the audience produce various cognition images. Reed (1972)[5] brings forward the prototype theory to account for the common characteristics of different faces so as to form the prototype effect[6,7]. This theory stresses that the human brain stores many prototypes, which if compared with the facial stimuli seen, a pattern recognition will be fulfilled. The author attempts to make an aesthetic & cognition analysis and design method construction on the character personality in 3D movies according to above theories.

This study aims to explore the audience's cognition on the negative personality design as well as the design norms of the figure molding based on the figure analysis of 3D animation produced by PIXAR. These norms can be applied into graphic art education, such as in cartoons, picture books, and the specific figure design in enterprises. The expression of the character personality will leave an impressive image on the audience's minds. The objective of this study is as follows: (a) analyze the negative personalities of the PIXAR animation figures and their facial types, shapes, and relational angles (see Sec. 3.1) and (b) investigate the negative character of the audience's cognition. For the cognition degree and profile features of a negative character's features, please see Sec. 3.2.
1.2. Definition of a Negative Personality

Most people believe that the personality or appearance of a person provides information about one's inherent character, even his/her possible reaction capability[8,9]. Bad descriptions of people's character belong to negative impressions[10]. After classification, the adjectives used to describe a relevant negative personality include wicked, bad, atrocioues, frantic, malevolent, surly, terrible, outrageous, flagitious, ferocious, wolfish, cruel, uncivil, miscreant, crafty, impish, insidious, wild, and ruthless among others [11,12,13]. Role is defined as the function relevant to the distinct position in the social background [14]. A character's negative personality refers to its wicked and immoral quality, which is also referred to as the bad and foul personality in PIXAR films [15]. This research aims to discuss the design tendency of facial features rather than a distinct negative personality pattern.

1.3. Research Limitation

This is the initial research on the relation between negative personality and shape design, which can provide reference for the logical design method employed in the reference literature about art education and role setting in cartoons. However, the shape and characteristics of a negative role in cartoon films depend on the plot of the story, and thus the limitation is set to collect all research samples. Six popular animated films with good quality are taken as samples for this research: *Toy Story*, *Toy Story 2*, *A Bug's Life*, *Monsters, Inc.*, *Finding Nemo*, and *The Incredibles*, which were produced by the top cartoon studio PIXAR from 1995 to 2005. The shape of the characters produced by PIXAR tends to be realistic, and the roles include human beings, animals, insects, and monsters that are all vivid and interesting. During sample sortation, the characters with negative personalities were considered. This research only aims to make a survey on the facial features' impact on negative personality rather than the countenance, limb movement, and decorations for clothes.[16]

2. Literature Discussion

2.1. Pattern Recognition of the Character Personality Design

Perceptual course is a process in which one will respond to the specific property of one thing and store, extract, and apply the stimuli information when he or she receives the sense stimuli[17,18]. Lasseter (1987)[19] pointed out that character without charm will make the audience feel bored about the character that has been designed. Therefore, it is necessary to intensify the facial features to attract the audience's attention and achieve their perception reaction when constructing the character negative personality. The fundamental principles in character design for the personality representation is to know the story style and the characteristics of the figure image and then design its expression and profile [20,21].

Facial features play an important role in one's face recognition process according to research[22,23]. A clear explanation on the strategies of an individual's processing of facial recognition have not been offered through psychological and nerve science though they provided some presuppositions on the institution of facial recognition [24,25]. Therefore, the question is: Is the recognition of a character's features in one's experience available in different persons? Bradshaw and Wallace (1971)[26] found that one's facial features will affect the reaction time during the comparison toward the facial feature recognition process. Reed (1972) discovered the prediction mode of facial modes with different weights by using the category experiment of basic mode. Walden and Field (1982)[27] also pointed out that eyes are the critical part in the facial recognition. Therefore, once the character personality feature becomes similar to some features available in one's experience, it can be recognized well. There exists a prototype for the character negative facial expressions because one's recognition on various character personalities through media in their visual experiences. Lombroso (1876)[28], in his On Criminal Man, described the physical features of the inherent criminal: the defective and abnormal eyes, ears of queer size, distorted and upwardly hooked bridge of nose, swell and extruded lips, etc.. Hence, the audience can comprehend the impressive image left by the character personality immediately when they recognize the figure's negative character features. The objective of this study is to find out the negative character features of the audience's cognition (see Sec. 3.1.4 (a)) and construct the effective design method so as to intensify the design of character personality and its profile feature (see Sec. 3.1.4 (b)).

2.2. Character’s Profile Drawing and Relational Angle of Facial Parts

As for the eyes, if the profile of one object is clear along with a regular feature, an object can be recognized according to its profile visually. Usually the cartoonist or the painter can reproduce one's personality only if he or she captures the feature of an object (see Figure 1)[29,30]. Therefore, the real shape of one object can be determined
by its spatial features. Figure profiles in Picasso's paintings can also indicate that one's correct recognition towards the facial parts results from the relationships between itself form structure and its parts (see Figure 2)[30].

Shi (2004)[20] pointed out in his Model with Animation that diversified character models can be created through the position and angle between facial center line and relational line, e.g., Table 1. This paper attempts to investigate the relationship between the character's negative personality and his or her facial parts to outline the model design of the character's negative personality (see Sec. 3-1.4c). Features of the character personality are determined by its structure description which will make the audience sense his or her negative image. Therefore, design norms of the character negative personality can be defined through investigation and analysis.

Steps of character drawing start from the simplification of profile, e.g., Figure 3. The head of the human being is usually constructed by a circle, a horizontal line, a vertical line and a relationship line. These are marked one by one in order to mark the positions of the various facial parts, e.g. Table 2. Hence, (a) the vertical line is the auxiliary line plumbing with the philtrum and the horizontal line, (b) the horizontal line is the auxiliary plumbing line between the lower edge of the facial parts and the vertical line, (c) the relational line is the auxiliary line by which one can master the facial parts quickly during the profile composition's deterministic process. In Table 2, the relational line of the facial pairing parts, like eyebrows and eyes, is the connection line linking the left and right points of the profile. On the other hand, in singular parts like the mouth and teeth, the relational line is the connection line between the intersection points of centerlines which are plumbing with the part profile and the left and right points of the part profile. In this study, the relational angle involving the vertical line, horizontal line, and relational line are taken as the variable of the negative personality. The so-called relational angle refers to the angle between the relational line and the vertical line made counterclockwise. It can be classified into three groups: (i) $0^\circ<\angle$ the angle between the relational line and the vertical line $<90^\circ$ (ii) the angle between the relational line and the vertical line $=90^\circ$ (iii) $90^\circ<\angle$ the angle between the relational line and the vertical line $\leq 180^\circ$, as shown in Figure 4.

![Figure 1. Head (abstracted from Ibid., p.32)](image1)

![Figure 2. Various Figure Profiles in Picasso's Paintings](image2)

![Figure 3. Drawing Steps of Facial Parts' Depiction (abstracted from Cowan, 2003, p.20[31])](image3)

<table>
<thead>
<tr>
<th>Table 1 Norms of the Animation Character's Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Types of the Norm / Models of the Norms</td>
</tr>
<tr>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>Face</td>
</tr>
<tr>
<td>Expression</td>
</tr>
<tr>
<td>Mouth</td>
</tr>
</tbody>
</table>

(abstracted from Shi, 2004, p.77[20])
McCloud (1993)[32] argued in his Understanding Comics that the image of the character will be transformed into the information through the physical feature simplification so as to be remembered conveniently, e.g. in Figure 5. According to the description of Blair (1995)[33] about the negative character’s profile, the negative character is often endowed with the following features: heavy and long arms, big hands, bushy eyebrows, small ears, eyes with a small distance, thick lower lips, small cranias, and big chin and jawbone. Therefore, the shape of the facial parts will be recognized first and remembered when character’s negative personality is perceived by the audience. This study will discuss the character’s negative personality and its profile design. At the same time, it proposes an effective method for designing the character personality through the summarization and analysis on the facial parts of PIXAR animation characters.

2.3. Fundamental Principles and Elements for Character Personality Design

Currently, depictions of character’s expression and its body activity are emphasized particularly in books about character’s personality design[34,35,36]. Thomas and Johnston (1981)[37] drew a conclusion that fundamental principles of well-knit depiction and attractiveness are closely related to the character’s personality design in their collation of the gesture action and profile representation. Peculiarity representation should be depicted to extrude the character personality when creating a character[38]. To stress the feature of the character profile and extrude the representation of the character’s personality, it can resort to the simplification, exaggeration, and transformation of the design elements[39,40,41,42]. Hence, this paper focuses on the construction and design of the character’s negative personality to investigate the audience’s cognition toward the character’s negative extent (see Sec. 3.2.3 (a), (b)). Furthermore, it concludes some profile features of character’s negative personality (see Sec. 3.2.3 (c)). It is hoped that the results of this research would be helpful in graphic art education and character personality design.

3. Character Personality and Profile Design Method

This study aims to upgrade designer’s effective mastery of the character’s personality based on the character’s personality setting and referential data of the design representation from the empirical research method. Fist stage involves the application analysis of the negative personality of PIXAR animation character, whose research method adopts the expertise team to classify and analyze the design feature of the facial parts of the character’s personality. The second stage, on the other hand, involves the conclusion of the recognition extent and profile feature of the character’s personality design according to the pattern recognition theory. Framework and procedure of this study is shown in Figure 6.
3.1. Survey of Character's Personality

Based on the character's negative personality design in PIXAR animation movies, survey objectives of this study are as follows: (a) to analyze the application of the facial parts of the character's negative personality in PIXAR animation movies; (b) to discuss the second-order relational angle among parts of the character's negative personality from the perspective of pattern recognition. Survey items of the first stage are the following: (i) numbers of the facial parts employed; (ii) shapes of the facial parts; (iii) relational angle of facial parts.

3.1.1. Classifications and Sampling of the Survey Samples

In the collection and classification stage of a character's facial features, up to 407 pictures and cards depicting a character's negative personality were sorted by the researcher. Before classification, the researcher indicated that a character's negative personality refers to its wicked, immoral, and bad qualities classified according to the agreement of the team of experts. If a disagreement would occur, the classification would be analyzed again through a discussion. Six experts who have more than five years of experience in character design or animation design were invited to classify 407 character picture segments of facial expressions. They were asked to omit those without negative character personalities, with unclear expressions, and with similar expressions. They were then asked to choose 97 representative pictures of characters with negative personalities. In addition, they recorded them as the samples for the first stage, as shown in Figure 7.

3.1.2. Manufacture and Representation Modes of Samples

First, the movie is transformed into an AVI format with SmartRipper, then opened in Adobe Premiere to capture the segment, after which the sample is produced as shown in Figure 8. The negative character representation chosen are those with vivid feature segments according to the story plot, action expression. Finally, segments shots are transferred into Adobe Photoshop and made into grey-rank picture of 10*10 cm as shown in Figure 9.

3.1.3. Steps of Investigation Items

(a) Investigation of the number of facial parts employed: facial parts of the character negative personality such as eyes, eyebrows, nose, mouth, ear, teeth are calculated out of 97 samples.
(b) Investigation of the facial parts' shape: character's negative personality varies according to the different facial parts from the investigation result of above (a). Therefore, the sample is put into Adobe Illustrator to depict the profile shape of eyes, eyebrows, nose, mouth, ear, teeth. At the same time, profile shapes which can represent the character's negative personality are analyzed.
(c) Investigation of relational angle of facial parts: relational angle among the facial parts of the character personality will play an absolute influence upon the representation of the personality. As a result, the degree of the angles which represent character negative personality are necessary to be investigated.

3.1.4. Results and Discussion

(a) Number of facial parts employed: It is indicated in Table 3 that employment of the eyes and mouth account to

![Figure 8. Sample of the Captured Picture](image)

![Figure 9. Sample of the Captured Picture](image)

Table 3 Quantity Statistics of the Facial Parts Employed in Character Negative Personality

<table>
<thead>
<tr>
<th>Quantity of Facial Parts Employed</th>
<th>Eye</th>
<th>Mouth</th>
<th>Teeth</th>
<th>Nose</th>
<th>Eyebrow</th>
<th>Ear</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>100%</td>
<td>100%</td>
<td>83%</td>
<td>65%</td>
<td>52%</td>
<td>43%</td>
</tr>
</tbody>
</table>
100%, teeth 83%, nose 65%, eyebrows 52%, and ears 43% in the representation of the facial parts of the character's negative personality. It was observed that the eyes and mouth are the most indispensable elements in facial parts for the negative character personality. It is necessary to stress these features so as to make the audience recognize the character's negative personality clearly.

(b) Shape of the facial parts: Table 4 is the facial parts design of the character's negative personality in PIXAR animation movies, which is described as follows:

1) Usually slim is the shape of the eyes which always leave a sinister and reserved impression to others especially when the negative character ponders.
2) Eyebrows are also represented by slim shape, which usually shows the nervousness and tension of the character.
3) Mouth usually pouts upward when it is open, the more it pouts upward, the more negative the character becomes.
4) Teeth are mostly designed as sharp shape which usually represents the monster so as to depict their fierce and cruelty.
5) Nose is always designed as sharp and slim shape, whose extent exerts a relative influence on the character's negative personality.
6) Ears appear to be semicircular usually with little depiction in detail, which exerts little influence on the character's negative personality.

(c) Relational angle of the facial parts: relational angle among the eyes, eyebrow, mouth and nose mainly is $0^\circ < \angle \text{between the relational line and vertical line} < 90^\circ$ while the ear relational angle mostly is $90^\circ$ (see Table 5). When relational angle between the relational line and central line $< 90^\circ$, it appears upwards which leads to sharp feeling toward the spatial array of the facial parts. Second-order relational angle among the facial parts of the negative personality can influence the audience's cognition toward the image of the character personality design.

From the analysis on the facial parts of the character's negative personality, we can see that eyebrow, eyes, nose mostly are slim and mouth mainly is with upward lips, while teeth mainly are sharp. Second-order relational angle among the facial parts of the negative character inclines to be $0^\circ < \angle \text{between the relational line and vertical line} < 90^\circ$ from the perspective of pattern recognition. Whole profile of the negative character with the sharp design feature can construct character's negative personality at the best. Ears without detailed depiction in facial parts of the character's negative personality incline to be semicircle and always covered with hair or head decorations, which results in the little influence on the character's negative personality. Among the facial parts, eyes and mouth can embody negative character at the best. If adding eyebrow and teeth depiction, it will even facilitate the function of eyes and mouth expression, under this condition, the character's personality will be more lifelike.

3.2. Pattern Recognition Investigation of Character's Facial Parts

It is helpful for the character design after discussing the character's negative personality at the first stage the above. In the second stage, we will discuss the feature property of the character's facial parts to find out the modeling reference.

<table>
<thead>
<tr>
<th>Name of the Part</th>
<th>Feature of the Shape</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eye</td>
<td></td>
</tr>
<tr>
<td>Eyebrow</td>
<td></td>
</tr>
<tr>
<td>Mouth</td>
<td></td>
</tr>
<tr>
<td>Teeth</td>
<td></td>
</tr>
<tr>
<td>Nose</td>
<td></td>
</tr>
<tr>
<td>Ear</td>
<td></td>
</tr>
</tbody>
</table>

Table 4 Analysis of the Facial Parts' Shape in Character's Negative Personality

<table>
<thead>
<tr>
<th>Relational angle (%)</th>
<th>Eye (%)</th>
<th>Eyebrow (%)</th>
<th>Nose (%)</th>
<th>Ear (%)</th>
<th>Mouth (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0^\circ &lt; \angle \text{between the relational line and vertical line} &lt; 90^\circ$</td>
<td>55.7%</td>
<td>70.8%</td>
<td>69.8%</td>
<td>35.7%</td>
<td>47.4%</td>
</tr>
<tr>
<td>angle between the relational line and vertical line $= 90^\circ$</td>
<td>29.9%</td>
<td>12.5%</td>
<td>30.2%</td>
<td>52.4%</td>
<td>28.9%</td>
</tr>
<tr>
<td>$90^\circ &lt; \angle \text{between the relational line and vertical line} \leq 180^\circ$</td>
<td>14.4%</td>
<td>16.7%</td>
<td>0%</td>
<td>11.9%</td>
<td>23.7%</td>
</tr>
</tbody>
</table>

Table 5 Relational Angle among the Facial Parts of the Character's Negative Personality

Figure 10. Twenty-three Pieces of Profile Picture of Negative Personalities in this Study

Figure 11. Likert Scale of Character's Negative Personality
data for the designer on setting of the character's personality and its representation. This stage aims to: (a) discuss the difference of the negative personality's representation features among various facial parts and (b) find out the cognition tendencies of the audience toward the facial features of the character's negative personality. Investigation items of the pattern recognition at the second stage include: (i) the extent of the character's negative personality and the (ii) profile design of the facial parts of the character's negative personality.

3.2.1. Sample, Object and Method of this Research

The number of test samples was limited to avoid the research results to be influenced by the testees' fatigue resulting from having excessive samples. The same group of experts omitted those pictures without negative personality features or with similar expressions and chose only 23 representative pictures from the 97 gathered at the first stage according to purposive sampling (see Figure 10). The samples surveyed were shown in black and white. The questionnaire adopted the Likert scale. At the initial testing stage, the testees responded that they have seen at least one of the sample films for their great popularity. Therefore, to construct the aesthetic cognition of a character's personality and analytical design method, convenience sampling was adopted in the test. They in this research were required to have watched more than two PIXAR animation movies, and they should have a higher education background. The testees were composed of 60 students aged 18 to 28 years old. Before testing, the definition of a negative personality and the instructions were explained to the testees: “To investigate the negative personality design and manifestation of shape features, please evaluate the character's negative personality in the picture. If you think its negative degree is the strongest, you can give it a rate of 7. On the contrary, if it is the weakest, you can give it a rate of 1.” The test began when the testees had no questions about the definition and the research procedure.

3.2.2. Design of the Questionnaire

(a) Questionnaire design of character's negative personality: This study makes a comparison among the samples through a survey to find out the difference extent among negative characters as well as to identify the most negative features of the character's facial parts. Testee is required to evaluate the 23 face cards of negative character according to 7-order Likert scale of "strength of the negative level." The negative level ranging from the weakest to the strongest is 1-7 points, as shown in Figure 11.

(b) Questionnaire design about profile design of the negative character's facial parts: the most easily identified facial parts of the character's negative personality for the audience is investigated in this paper based on the shapes of the eyes, eyebrows, nose, mouth, ears, and teeth. The testee is asked to give the order of the facial parts' profiles according to the sequence of the strongest negativeness (1) to the weakest negativeness (6) by using the research results of the facial parts' shape got at the first stage (see Figure 12).

3.2.3. Results and Discussion of Pattern Recognition of Character's Facial Parts

(a) Survey on the Negative Character's Extent

The maximum average of the negative degree was 6.3 (highest), and the minimum value was 2.8 (weakest). The integral negative degree was obtained after ordering the average values in this study. There was a difference among the facial profiles of the negative characters included in Figure 13. Items 22, 11, 21, 8, and 15 had the strongest negative

![Figure 12. Sequence of the Negative Extent of the Character's Facial Parts—Teeth Paradigm](image1)

![Figure 13. Sequence of the Negative Extent of the Character's Facial Parts](image2)
degrees of a character’s facial profile, while item 10 was the weakest. Through the various standard deviation values, the marks evaluated by the testees differed in the facial feature pattern of No.22 with the strongest negative degree and No.10 with the weakest negative degree, while the impression of a character’s negative degree in No.12 was inclined to be the same. It can be concluded that testees’ impression depended on the shape and proportion of the eyes, mouth, and teeth.

(b) Analysis on the Facial Profile of the Strongest Negative Extent
It was observed in this study that although some sample characters had no eyebrows, decorations, eyebrow bone, or upper eyelid muscles could represent the eyebrows. The eyebrows, eyes, mouth, and teeth are the important facial feature of the negative character. As shown in Table 6, the eyes are mainly narrow and with an upward tilt, which emphasizes more the character’s negative personality. When negative personality is tempered, it usually employs the expression of bursting into laughter. Mouth and teeth are the easily focused part for they account for the most area on the face. When designing the character’s negative personality features, mouth and teeth incline to be the design pivots, in which mouth mainly is with a slim and upward inclination and teeth are endowed with irregular, exposed and sharp features. All of these intensify the character’s negative extent. Moreover, sharpness of the teeth is much more helpful for the negative image when comparing with the mouth feature. In addition, the nose and ears are difficult to express and design because they have a low influence on the pattern recognition on a character’s negative personality.

(1) Eyes: All are slim with upward canthus (No. 22, 11, 8).
(2) Eyebrows: They are usually with upward canthus and triangular eyebrow top (No. 8). Though some characters have no eyebrows, decorations, eyebrow bone or upper eyelid muscles can represent the eyebrow (No. 22, 11, 21, 15).
(3) Mouth: Mainly open with upward mouth corners. Mouth is the easily focused part for it accounts for the most area on the face (No. 22, 11, 21, 8, 15).
(4) Teeth: Usually with irregular and sharp shape which entails the character with cruel personality (No. 22, 11, 21, 8, 15).
(5) Nose: Tips of the nose inclines to be triangular (No.22) and other characters have no nose parts (No. 11, 21, 8, 15).
(6) Ears: Mainly semicircular with little detailed depiction (No. 8, 22); there are no ear parts in No. 11, 21, 15 because they exert little influence on the character’s negative personality.

(c) Survey of the pattern recognition of facial parts
Testee’s recognition of the character’s negative personality profile is concluded in this study, as shown in Table 7.

Comparing the results in 3.1.4 with the conclusion shown in Table 4 on the experts’ cognition of facial features of a negative character, only the cognition of the ears’ shape is different. The modeling features of the facial features of a character’s negative personality are mainly narrow or triangular. In other words, the shape of the acute angle is often taken as the representative feature of the negative character. The features are summarized as follows according to their shape:

(1) Shape of the eyes: slim and acute.
(2) Shape of the eyebrows: slim and upward, with an triangular upper edge.
(3) Shape of the mouth: corner upward and an overall triangular shape.
(4) Shape of the teeth: irregular and acute.
(5) Shape of the nose: slim and with a triangular tip.
(6) Shape of the ears: slim.

4. Conclusion and Proposals
The aim in constructing the character’s negative personality in this study, especially the facial feature, is to offer an effective method to create character’s personality for designers. It is summarized as follows: The facial profile design of the character personality feature inclines to be slim and triangular with an upward angle (relational angle is \(0^\circ < \alpha < 90^\circ\)) or angle between the relational line and vertical line less than \(90^\circ\). The influential elements in facial parts affecting the negative extent are mainly the eyebrows, eyes, mouth and teeth, in which the mouth and teeth are the most influential parts, while the nose and ears are the relative secondary parts (See Sec.3.1.4). This paper outlines the extent of the character’s negative personality in PIXAR animation figures and explores the pattern recognition toward the character’s
negative personality form the audience’s perspective. Furthermore, the most representative modeling feature for creating a character’s negative personality are concluded. Therefore, various characters’ personalities can be created according to the facial parts of different negative extents (See Sec.3.2.3).

In the past, it depends mostly upon the designer’s individual experience, observation, and aesthetic accomplishment whatever on the cartoon modeling design or character’s personality setting. This method lacks systematic investigation. In view of this, this study focuses on the pattern recognition of the facial parts’ shapes of 3D characters and the relational angle cognition among the various parts as well as the recognition extent toward the negative personality they constructed. Furthermore, design method for constructing the character personality is put forward to facilitate students and designers’ mastery on the 3D character’s features and model design. In addition, methods and results of this study can also be applied into the design of the corporate character and graphic character personality (e.g., cartoons and dolls). This study collected character negative personalities from actual animation movies and outlined the design modeling trends. It can be concluded from the survey results that the eyebrows, eye, mouth, and teeth are the influential facial features of negative character. Modeling feature of the facial parts inclines to be slim and triangular when the audience recognizes the negative character personality. It is obvious that PIXAR character’s personality design in its plot depiction is successful from the best-seller of their works in market though this study of the negative role character is limited in the works of the PIXAR cartoon corporation.

As an initial research on the relation between a character’s personality and shape design, and with limited manpower, materials, and time, this study only discusses the features of a character’s negative personality and the design of a facial feature profile as gathered from the testees who have seen PIXAR animated films, but it does not cover the body features, gestures, fineries, and ornaments. Thus, the authors suggest subsequent research to investigate the manifestation of facial features in different personalities by surveying testees who have not seen any of the PIXAR animated films. As for the pattern of negative personality, researchers can pay attention to the importance sequence of the representative facial features. For example, various expression changes are positively found in human being characters, as shown in Table 1. The future research suggestions for this study are as follows: (a) to investigate the interaction between viewers’ cognition of a negative character’s personality and facial features through experimental operations on the modeling and through the relationships among the facial features; (b) to examine the viewers’ recognition of a negative character’s personality using painting skills, color, and texture; (c) to investigate further the design modeling patterns of a negative character’s features and facial expressions, such as evil, bitter, and so on, or extend it to a study on the patterns of a positive character design of other characters, such as open-mindedness, optimism, and so on. This study’s structure and process can be used for reference as well. As this initial research has chosen characters only from PIXAR films, the authors recommend using a more extensive and diversified sample for relevant or subsequent research. Thus, the research results can be used to determine character design differences among different animation figures of different studios.

Endnote
1 Second-order relational properties: Diamond and Carey (1986) proposed that spatial position of components of one object are endowed with a fixed and optionally irreplaceable property (Diamond & Carey, 1986), such as the facial parts (eyebrows, eyes, mouth, ears, and nose). They are called the second-order relational properties. In comparison with the second-order relational properties, if the components’ spatial position of the object are not fixed and can be replaced arbitrarily, the relationship of components is called first-order relational properties, for example, the position of the trees in a landscape can be changed arbitrarily.[4]
2 Relational angle: The angle between the relational line and vertical line are set counter-clockwise.
3 Relational line: It can facilitate the mastery of auxiliary line of facial profile quickly during compositing a picture. It is defined in this study that it is the connection line between the left and right points of the parts and the profile. This part is endowed with pair properties (like eyebrow and eyes). If the part is with singular property (like mouth and teeth), its definition is that the segment line between the intersection points made by the centerline of the vertical part’s profile and either left or right point of the part’s profile.

5. References
41. Chu SC. Study of the application of the comics on animation: Using the cartoon style and the comics symbols as the Key. Master’s thesis, Department of Multimedia and Animation Art, National Taiwan University of Arts, Taipei, Taiwan, 2004.