Find a meaning within character silhouette:
Stylized character design support method using silhouette

Rianti Hidayat  Akinori Ito  Kengo Watanabe  Koji Mikami  Kunio Kondo
Tokyo University of Technology

kiha.sal.valeth(at)gmail.com  {akinori, mikami, kondo}(at)media.teu.ac.jp  kendo(at)mediatelier.net

Abstract
A Character Designer is required to propose a lot of design alternatives with a wide variety of shapes, sizes and proportions. For that purpose, professional designers recently recommend methods using silhouettes. However, there aren’t any rules or guidelines for this method so it may take years of learning for novice artists to utilize this method properly. This research is aimed to support character shape explorations using silhouettes by creating a “Silhouette Scrapbook” system. In order for this to be achieved, it is a necessary to find the basic rules for silhouette methods by studying the relationship between the existing silhouette shapes of characters and their role in a story. First, we collected 169 characters from the animation box-office list, converted them into silhouettes and analyzed their basic shapes. We found evidence that suggests the following insights. First, there are different ranges of variation for each role. Second, the definition of a unique character, whose shape lies outside the basic variation range, becomes clear with this paper.

1. Introduction
A professional character designer is required to propose a lot of design alternatives in order to fulfill the requirements for each project. Especially, in the fast-paced industry, where one designer can jump from one project to another, a designer should be able to propose design ideas with a wide diversity of shapes.

Creating character designs with a wide variety of shapes, especially outside of one’s own preferred style, is not an easy task. Design expertise necessary for that purpose is acquired from learning basic concepts, assimilating domain knowledge, inspection of established examples requiring years of practice and experience [1]. Thus, various researchers have been attempting to create support tools in the design process.

One of the support tools is called Shape Grammar which generates the family of design shapes [2]. However, there are few signs in any widespread use of it in design related industries and they are still incapable of replacing a designer’s own exploration. In addition, there are also applicable tools such as “Photoshop”, “CAD”, etc. which are widely used in the industry but have been used as a support tool for “presentation drawing”, not “exploration drawing” [3] which was created for idea generation. At this point, it could be said that there are very few tools are available to support the process of character shape, exploration and ideation.

On the other hand, professional designers recommend character design methods using silhouettes. The ambiguous characters of silhouettes are supportive of idea stimulation with silhouettes. Therefore, designers are able to get clearer picture of overall character shapes [4]. However, there aren’t any rules or guidelines for this method so it may take years of learning for novice artists to utilize this method properly.

Essentially, this research proposes to underwrite character shape exploration using silhouettes by creating a “Silhouette Scrapbook” system. A “Silhouette Scrapbook” provides templates (consisting of basic shapes within a frame) with intervals which can be adjusted by the user. A user, who intends to create widely acceptable character, can explore within the limit of the number of silhouettes frames. Some prefer to challenge their design capabilities by going outside that limit and create unique-shaped character designs. This research will be focused on non-realistic, Pixar-like, and Disney-like, which from here, would be written as “Stylized”.

In order to achieve that, there is a necessity to find the basic rules in the silhouette method by studying the relationship between existing character silhouettes which facilitate their role in the story.

By discovering these insights, we can provide the designer with basic silhouettes to begin with, in addition to providing specific intervals to be explored within their desired roles.
The basic silhouette is extracted from the mean and standard deviation value, in addition to the shape tendency for each category.

According to The RIBA and Goel models \[^3\], design process (character design process included) consists of a sequence of activities. It starts with problem structuring and continues with problem solving. “Silhouette Scrapbook” will be placed on the design process between problem structuring and problem solving as shown in figure 1.

Figure 1. This research’s solution overview placement in character design process

2. Previous Work

2.1 Character Design Process related research

Character design process starts with a background story proposed by Director then continued with the ideation process by designer. In order to bridge the communication gap between Director and designer, Watanabe \[^9\] proposed the Character Collage System. However this system produces detail-packed design and is not oriented for ideation purpose.

2.2 Character’s shape related research

Ashraf\[^6\] studied the relation between shapes and stereotype labels. Various character shapes were collected and applied to a game for data collecting. His research shows insights of how shapes are perceived by consumers; but it is comprised of limited parameters which haven’t been applied to ideation support. Nguyen\[^7\] tried to increase the analysis parameter; however it was restricted to the face.

Tanvir\[^8\] proposed special algorithms to extract the basic shape of characters. However, this research includes the same parameters used by Ashraf and is considered inadequate for character design.

2.3 Character design method

Through investigations of various tutorial online and how-to-draw books, character design technique is split into two groups. With the Atari method, the designer uses lines to create characters. Secondly, as demonstrated in figure 2, silhouette based character design is a technique that has recently become popular among professionals.

Figure 2. 2 types of character design, Atari (Line drawing technique) and Silhouette drawing technique

3. Silhouette Scrapbook

The Scrapbook definition used for this research is based on Motegi’s system \[^9\]. This personal system allows users to collect various character images, applying the impression keywords into it. However, the scrapbook, to be created in this research, is not only meant for personal use but is expected to be useful for both novices and professional designers.

This research’s silhouette scrapbook began by collecting both the character silhouette data and its background story. Those silhouettes were converted into basic shapes while the character background story was converted into several keywords. The silhouette scrapbook’s structure is shown on figure 3.

Figure 3. Silhouette Scrapbook’s structure

4. Silhouette Analysis

In order to find some tendency in the relationship between keywords and silhouette shapes, character silhouettes have to be simplified using several steps. The process will be explained below.

4.1 Method

The purpose of this research is to find useful tendencies for the actual design phase. It means that silhouette templates will encourage designers to draw various characters based on a brand new idea. In order to get the result, the method needs two steps.
First, the typical generic silhouette’s shape for each role by using average and standard deviation must be found. Secondly, the shape of the character’s silhouette lying outside the range of the typical generic silhouette has to be distinguished.

Character silhouette data was collected from animation titles which have been profitable worldwide. In order to widen the character variation, the data also includes the list from those titles which have earned Academy Awards (OSCAR). The titles were collected from 2004 - 2010. Each character silhouette was converted manually into simple shapes without any accessories such as a hat or a hairstyle. The shapes then were posed into normal standing poses by straightening the character’s back bone structure as shown in step 2, figure 4. The figure was then divided with Pose Proportion Abstraction for the purpose of analysis. Pose Proportion Abstraction parameters are too simple for character design so the silhouettes were divided into more detailed parts such as the upper and lower arm and the upper and lower leg, etc. Aside from these parameter, this research adds the Law of Third (LOT), a distribution of character balance into 3 parts (head and neck, upper chest, hip and leg) found in the technical drawing tutorial book recommended by professionals. This was done to make sure the research is applied to the technical knowledge of the industry so it can be used for real design works. The steps above are described in figure 4 below.

For keyword data, this research uses role keywords from Motegi’s research such as Main Character, Supporting Character, Rival, Client, and Enemies. This research also applies contents role keywords such as the Hero, The Anima/Animus, The Mentor, The Shadow, The Fool, and the trickster. This completes the analysis of Motegi’s role keywords and we can continue with the analysis of Contents role keywords. The parameter used for this analysis is described in figure 5.

### 4.2 Silhouette shape analysis

Since this research is meant to support designers in creating a wide variation with their designs, it is necessary to find out the basic range of variation for existing characters. In order to do this we collected 169 characters from 16 titles, calculating the mean average and standard deviation.

From this analysis we found a correlation between character proportion and its role in the story. For example, if the LOT upper point is considered 1, the male main characters have an average LOT ratio of 1:1:2:5. Meanwhile its standard deviation minimum ratio is 1:0:6:1.4 and the maximum ratio is 1:1:7:2.7 as shown in Table 1 and Figure 6.

**Table 1. Male Main Character Height Proportion Analysis**

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<th>Nec</th>
<th>Sho</th>
<th>Bre</th>
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<th>Dist</th>
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<tr>
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<td>2.3</td>
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<td>1.6</td>
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</tr>
</tbody>
</table>

**Figure 4. Character Silhouette analysis process**

**Figure 5. Proportion analysis parameter**

**Figure 6. Male Main character height proportion ratio**

With this result we know the proportion range of the roles of existing characters. Therefore, characters having ratio variables outside this range are unique. From the data collected, there is a variation in ratio value distribution. Some roles, like female main characters, have only 1-2 variables lying outside the average, while supporting character has 5 or more variables outside the average. As indicated, there are different standards of uniqueness for each role.

For example, the kid version of “Carl Fredericksen” from “UP” has a LOT ratio of 1:0:3:0.5, “Tatischeff” from “The Illusionist” is 1:1:4:1.0 and “Gru” from “Despicable Me” is 1:2:6:4.8. Based on their height proportion ratio, they are unique characters in the Male Main Character category.

For the width variable, the character is divided into head, neck, shoulder, chest, waist, and hip.
If the head width value is considered 1, the male main Character average ratio is 1:0.5:1.6:1.2, 2:1:1:2, while the minimum and maximum values are: 1.0:1.0:0.6:0.6:0.6:0.6:0.6 and 1.0:0.8:2.3:1.8:1.6:1.8. Thus, “Prince Naveen” from “The Princess and the Frog” with ratio 1:0.8:2.9:2.4:1.6:2.2 and “Mr. Incredible” from “Mr. Incredible” with ratio 1:2.3:2.5, 1:9:1 can be considered unique.

In the Female Main character category, the average LOT ratio is 1:1.3 while their minimum and maximum standard deviations are 1:0.8:3.1 and 1:1.2:4. Meanwhile the width ratio is: 1:0.3:1:0.9:0.8:1.2 with minimum and maximum ratios are 1:0.2:0:8:0:7:0:6:9:0.9 and 1:0:4:1:4:1:2:0:9:1:6.

This means “The Girl” from “The illusionist” animation with a LOT ratio 1:1.3:4.3 and “Tiana” from “The Princess and The Frog” with LOT 1:0.9:2.8 and width ratio 1:0.4:1.4:1.3:0.8:1.8 are unique characters. “Penny” from “Bolt” with a LOT ratio 1:0.7:2.5 and “Coraline Jones” from “Coraline” with a Width ratio 1:0.2:0.5:0.5:0.5:0.6 can be considered the unique female main character as shown in figure 7.

From the ratio value findings above, we found out that the female main character proportion range is the smallest among other roles and is centered on the lower part of LOT. It can be concluded that female main characters have a certain ideal proportion standard and do not have much room for designers to explore. Female main character’s uniqueness can only be applied into the lower LOT (hip and leg) to add sexiness. Even so, lower LOT has a narrow range since very long female legs create an imbalance disproportionable when compared with other ratios.

Meanwhile, male supporting characters have an average LOT ratio of 1:1.3:2.5 with a minimum standard deviation ratio of 1:0.7:1.5 and maximum 1:1.9:3.5. Based on this value, “Stoick” from “How to Train Your Dragon” with LOT and a width ratio 1:2:4:1 and 1:0:3:2:3:1:3:4; “Calvin” of “Cloudy with the chance of the meatballs” with LOT ratio of 1:0.6:1.1 and width ratio of 1:1:1:1:1:1:0.9; “Dash Parr” from “Mr. Incredible” with a LOT and width ratio 1:0.2:1.1 and 1:0.3:0.8:0.7:0.6:0.6 which can be considered unique characters as shown in Figure 8. It is also the same case with “Vladimir” from “Rapunzel” with a LOT ratio of 1:2.8:3.4 and width ratio of 1:0:4:3:4:3:9; “Jackjack” from “Mr. Incredible” with a LOT and Width ratio of 1:0.3:0.6 and 1:0.2:0.4:0.4:0.5:0.5. “Greno” from “Rapunzel” has a LOT ratio of 1:2.3:1.8 and a Width ratio of 1:0.2:7:3:2:3:2:3:2.

The Supporting Character is the category with the widest proportion range among all categories. There isn’t an ideal proportion expected from supporting characters so it has become the area where the designer has more freedom to explore shapes.

The male enemy category with LOT has averages of 1:1.5:2.6, with a minimum ratio of 1:1.1:8 and maximum ratio 1:2:1:3.4. This means “Vladimir” from “Rapunzel” with a LOT ratio of 1:2:8:3.4 and width ratio of 1:0.4:3:4:3:9; “Charles Muntz” from “UP” with LOT and width ratio of 1:1:1:3 and 1:0:4:0:9:0:9:0:9; and “Greno” from “Rapunzel” with LOT ratio of 1:2:3:1.8 and Width ratio of 1:0:2:7:3:2:3:2:3:2 are unique among male enemy categories. On the other hand, the Female Enemy category has a LOT average of 1:2:2:5 with minimum ratio of 1:0:7:1:2 and a maximum ratio of 1:1:3:3:8. This means “Mirage” from “The Incredibles” with a LOT and width ratio of 1:0.6:3:3 and 1:0:6:0:5:0:3:0:6 is a unique character.

From 169 characters collected, character uniqueness stands out based on their shoulder degrees. These findings show that the parameters used for current investigations is still lacking for character design. The researcher planned an addition of the shoulder degree analysis and more keywords to enrich the results.

**4.3 Discussion and Future works**

From 16 titles, 13 titles are from American production studios (mostly dominated by Pixar, Disney, and Dreamworks), 1 is from the Irish-French-Belgian production studio, 1 from French, and 1 from Japan.
Dreamworks titles are: “How To Train Your Dragon”, “Monster vs Aliens”, and “Megamind”. Among those titles, “Monster vs Aliens”, and “Megamind” don’t have unique characters. We can assume that Dreamworks human character shape usually resides within basic range. However, “How to Train Your Dragon” has a 25% unique character percentage and surprisingly has earned more profit and has become more successful compared to two other titles. Pixar titles mostly have 20%-37.5% of unique human characters with the exception of “Toy Story 3”. This is probably caused by the low number of human characters in “Toy Story 3” which consists of lots of toys. Even so, the existence of unique characters within a title is related to profit and success.

Based on these insights, it is also worth studying the relationship between character shapes and titles from the producing counties or between character shapes and studio character traits. More research on could very well enrich the results of this study.

5. Conclusion

This research is focused on creating support for the designer in creating a wide variety of character design called “Silhouette Scrapbook”. However, it is necessary to define the basic range of existing characters in order to create a basic template. There is also a necessity to find the definition of a unique character to widen a designer’s ability to explore character shapes without dismissing their role. Currently, we have already analyzed 169 character silhouettes from 2004 to 2011 and we have found 17 which were unique in 3 role categories. There is also a distribution of 1-3 average unique characters in one title.

Based on this analysis, existence of unique characters are necessary for a title’s success. Even though the main character basic range is limited compared to other roles, “Carl Frederickson” from “UP” and “Gru” from “Despicable Me” have shapes far outside the basic range. This means that an understanding of the “leap” from what is normally common and the creation of characters with a wide variety of proportions are to be expected from a designer.

All this data will be applied to the “Silhouette scrapbook” template as a foundation for the designer to complete his work based on reliable resources essential for the creation of characters which will be successful in the marketplace. This research establishes guidelines for testing the effectiveness of The Scrapbook System in design production.

References

[1] Suwa, M., Gero, J. S. and Purcell, T. Analysis of cognitive processes of a designer as the foundation for support tools, in J. S. Gero and F. Sudweeks (eds), Artificial Intelligence in Design


