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EFFECTIVE SIMPLIFICATION FOR LOGO DESIGN

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Abstract

As a graphic mark, logo applied by companies to aid public recognition and identification that it is traditionally applied on print advertisements and in recent years in digital devices. The logo recognition ability becomes a challenge to make it readable in a small display. Therefore, there is a need for brands to ensure their logo is recognisable in different media. According some previous research, simplifying shape might be one of the solutions to increase the recognition ability that will be the core concept in this study. Therefore, this study seeks to investigate a systematic method to evaluate the level of simplicity. The result of experiment aims to provide a reliable and systematic measurement for logo recognition development in different media display and able to enhance the recognition ability before works be printed.

Keywords: Design informatics, recognition, simplification, logo design

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1 INTRODUCTION

As a graphic mark, a logo is applied by companies to aid public recognition and identification (Wheeler, 2009). Providing a recognisable and readable logo for users is undoubtedly always the aim of graphic designers. In recent years, one in fifty companies changed their names and logos for a variety of reasons; therefore, in order to adopt the changes of company name, adoption of new strategies or novelty, logos may need to be changed (Walsh, Mittal and Page, 2007). Logos are traditionally applied across media such as packaging, letterheads, business cards, signs and print advertisements, and in recent years in digital devices — specifically, nowadays apps in mobile devices have been popularised. There is therefore a need for brands to ensure their logo is recognisable across different media. Figure 1 shows some examples of how a logo of a fast-food company, Subway, appears across different media (a laptop and a smartphone display).

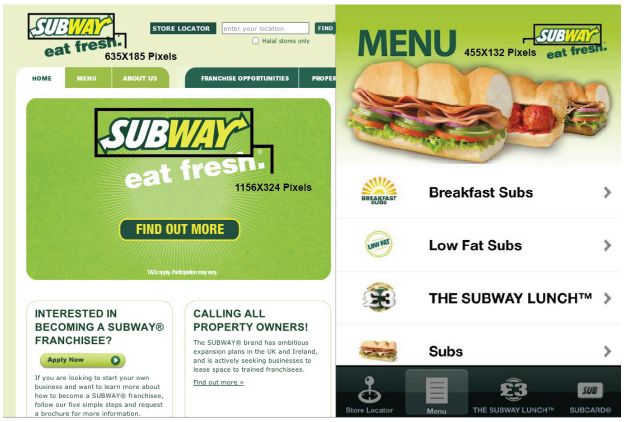


Figure 1. Examples of the Subway logo appearing on a laptop screen and a smartphone screen

Some logos can be distinguished easily and obviously, while others cannot be identified or recognised by viewers. As a medium of the brand and consumers, logos must have marked ability to increase high identification and recognition. Hence, the causes behind the outcomes are a valuable issue to explore. As previous studies have mentioned (e.g. Arnheim, 1967; 1974), simplification is considered a major element in designing logos, giving the ability to increase recognition. Designers sometimes simplify objects to obtain effective communication or a unique style rather than create realistic art works, simplified objects usually can enhance the memory of the images for humans. McCloud (1994) described graphic design as getting a strong impression/image through simplified objects (Figure 2).

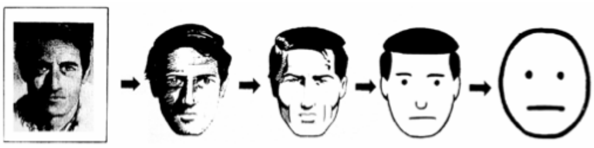


Figure 2. Simplification from object to figure (McCloud, 1994)

It seems that the response from graphic designers, when considering logo creation, is one of two types: ‘it looks visible’ or ‘it looks invisible’, this may be based on consideration of a range of factors among which form, open-closed, straight-curved, symmetry, weight, angles and components are probably the most important. To achieve the concept above, this study provides a review of a shape analysis method which was known as a key role in systems for object recognition, matching and analysis. According to some previous studies, Gestalt psychologists addressed the idea that graphic simplification could be a better way to facilitate the ability of image recognition. Graphic simplification aims to create images that contain simple graphic elements and yet efficiently represent real objects. Maeda (2006, p.16) described the easiest way to achieve simplicity as being through thoughtful reduction, simplifying a design is more difficult than making it complicated. Simplification means not only deleting the details of the objects, but also emphasising key points on specific details. Previous studies revealed simplification as the ability to express the characteristic of the object clearly, in addition to increasing the identity and memory (Gombrich, 1982; Arnheim, 1969; Zusne, 1970). Moreover, a good figure means to apply the least configuration to convey the identical information since the visual cognition of human beings is inclined to receive information by the most economical way (Koffka, 1935; Arnheim, 1969; 1974; Goldstein, 2010). Therefore, the initial concept of this study is to apply the simplicity method to enhance logo recognition ability. To solve this problem, the design concept starts with considering how to simplify the graphic, and whether any rule exists in subjective simple graphic decisions? This study aims to determine and explain a more systematic method to evaluate the level of simplicity. Therefore, the aim is to answer the questions: What would be an appropriate simplification method for a logo and how can its effectiveness be measured?

2 SHAPE ANALYSIS

Shape can be analysed according to different criteria and function. The principle of this study focuses on recognition with the argument starting with the degree of simplicity. The definition of 'good figure' in terms of redundancy among parts raises some new questions that concern the memory and recognition of form (Attneave, 1955). For example, are regular figures better remembered than irregular ones simply because they contain less information to be remembered? Does their priority persist even when information is held constant? In other words, which is remembered more accurately: a large, well-organised figure, or a small, poorly-organised figure containing the same amount of information? Therefore, a common problem in shape research is how to evaluate the degree of simplicity. Simplicity of shape analysis is hard to be judged on one specific factor. The first serious attempt at understanding graphic perception and graphic simplicity was undertaken through Gestalt theory. "There is an observable bias in our perception for simple configurations, straight lines, circles and other simple orders and we will tend to see such regularities rather than random shapes in our encounter with the chaotic world outside" (Gombrich, 1979, p.4). Gestalt psychologists proposed a set of laws to explain how vision groups elements in order to recognise objects (Pelli *et al.*, 2009, p. 36).

This study reviewed some previous visual perception experiments and applied them as the degree of simplicity criteria. Hochberg's (1948 cited in Vernon, 1970, p.33) visual perception experiment presented silhouette forms, and found that the threshold for recognition was the lowest with the simplest form, the circle; then for a rectangle and then for a cross. Bitterman (1954) also firstly found the lowest threshold for the circle, and then, triangle, T-shape, square and diamond, and cross respectively. Seven different forms were selected in Bitterman's experiment (circle, square, diamond, equilateral triangle, cross, *L*-shape, *X*-shape, *T*-shape and *H*-shape) as follows.

Figure 3. The forms used in Bitterman's experiment (Bitterman, 1954, p.212)

Attneave (1954) suggested that the number of errors made in guessing the outline of a form could be used as a measure of figural 'goodness' which provided an initial idea of node quantity and number and size of angles. Zusne (1970) argued that the node of a polygon is the concentrated point for human vision rather than a straight line. Hence, number and size of angles can be one of the available methods to explore simplification. Apart from the angle task, another method was taken by Marr (1982) which focused on segmentations or 'components'. Marr and Nishihara (1978) obtained the component axes from an image of a donkey. From this initial outline, convex and concave segments were labelled and used to separate the donkey into smaller sections. The axis was derived for each of these sections separately, and then these component axes were related together to form a stick representation for the entire figure. Figure 4 has six diagrams which reveal the concept of components: (a) the outline of a toy donkey; (b) convex (+) and concave (-) sections; (c) strong segmentation points; (d) the outline is divided into a set of smaller segments making use of the points found at (c) and rules for connecting these to other points on the contour; (e) the component axis is found for each segment; (f) the axes are related to one another (thin lines).

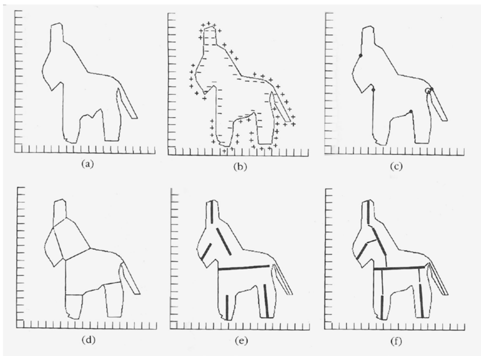


*Figure **4.** The programme derived the component axes from an image of a donkey (Marr, 1982, p.315)*

According to Marr's (1982) theoretical approach, Biederman (1987) proposed a theory of object recognition describing objects as consisting of basic shapes or simple components (Eysenck, 2001, p.74; Biederman, 1987, p.118); hence, for the recognition of an object the edge-based contour is extracted first, then decomposed and then comes the parsing or segmenting of its parts at regions of deep concavity into geons. This idea explains that there are mechanisms in the brain to recognise 3-D structural components of objects. Geons are 3-D shapes that can be curved or straight and in addition the geon components of objects is stored information in the brain, and combines with a structure skeleton which is a description of the way they are connected (Ware, 2008, p.110). Biederman (1987, p.115) argued that any single object can project an infinite number of image configurations onto the retina. An object can be presented as a simplified line drawing rather than a full-coloured image. Object recognition is conceptualised to be a logical process in which the image is divided into simple geometric components (Biederman, 1987, p.115).

Another task of the human visual system is to derive shape information about the shape segmentation from topological analysis (Hecht and Bader, 1998) based on computational theory which was addressed by Marr in 1982. The task proposed by Hecht (1998) was to classify patterns/shape by combining three topological properties - connections, components and inclusions (Figure 5). Comparison between objects with connected parts and disconnected ones, the reaction time of the former is quicker than objects with small gaps (disconnected) from which it could be concluded that a high degree of representational unity was captured by the reaction time of the object with connected contour (closed) rather than the one with small gap contour (open) (Hecht and Bader, 1998).

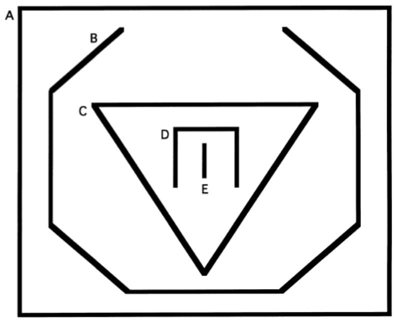


***Figure 5.** Three factors describe the topology of 2-D patterns: The number of components, inclusion relationship and connections (Hecht and Bader, 1998)*

Previous research has already provided some methods of visual perception; in general, most visual perception tasks focus on reaction time as the criteria. In contrast, this experiment starts with figuring out the simplicity principle or simplicity rules; therefore, the experiment in this study will extract some part of previous research for reference and add more categories for greater comprehensive consideration. Various studies have focused on discovering underlying shape characteristics; however, the experiment in this study extracts previous concepts as part of shape analysis factors – form, open-closed contour, straight-curved line, symmetry, weight, number and size of angles, and number of components.

3 EXPERIMENT

This study applied shape analysis to identify which elements can be used to measure overall simplicity and could possibly lead to better shape recognition.

3.1 Experimental Design

3.1.1 Observers

Twenty students enrolled at the University of Leeds (5 males and 15 females) took part in the experiment with an age range between 20 and 30. Each observer carried out the experiment twice and, therefore, the total number of observation results was 40.

3.1.2 Images

Seven elements (form, open-closed, straight-curved, symmetry, weight, degree of angle and number of components) were identified by shape analysis as the samples for the experiment to develop simplification measurement.

3.1.3 Hypotheses

The hypotheses of the study are stated in the following:

H1: Simplicity of shape is related to fundamental form (circle, triangle, …irregular).
H2: Simplicity of shape is related to the degree of closedness of the outline.
H3: Simplicity of shape is related to the shape with pure straight or pure curved form.
H4: Simplicity of shape is related to the shape with complete symmetry.
H5: Simplicity of shape is related to the shape with lighter superficial measurement.
H6: Simplicity of shape is related to the angle in the shape (over or under 180°).
H7: Simplicity of shape is related to the shape with fewer components.

Based on these hypotheses each element includes different levels of simplicity.

Form
The first step in producing form simplification was to create ten different levels of image using Adobe Illustrator software, based on fundamental shapes such as circle, triangle, square, diamond, polygon and further forms used by Bitterman, Krauskopf, Hochberg (1954), L-shape, T-shape, cross and H-shape, and adding an irregular shape as one of the options.

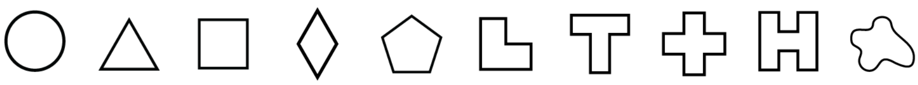


Figure 6. Form selection

Open-closed
Hypothesis two of simplicity assumes that shapes with closed outlines tend to be simple. Therefore, this experiment applied five levels of open-closed to test this. Each level was set up as a completely closed shape, 45°, 165°, 195°, 255° and open shape respectively.

Figure 7. Open-closed selection

Straight-curved
The third hypothesis assumes that the pure straight, such as a line, or pure curved shape, such as a circle, tend to be more simple. This experiment applied three figures as follows.

Figure 8. Straight-curved selection

Symmetry
As indicated in the literature review section, Hann (2012) depicted four different types of symmetry - translation, reflection, 2-fold rotation, and glide reflection. This experiment addressed a hypothesis that assumes that completely symmetrical shapes tend to be simple shapes, and translation, reflection, 2-fold rotation, glide reflection and asymmetry respectively.

Figure 9. Symmetry selection

Weight
The fifth hypothesis assumes that lighter or thinner figures tend to be more simple. This experiment used the following figures which eliminated other variables.

Figure 10. Weight selection

Degree of angle
The concept of the angle test is based on the previous study by Attneave (1954), and the first experiment in this study. According to previous results, this experiment aims to figure out the influence of convex and concave on the definition of simplicity. This experiment applied ten different degrees of broken line (90°, 120°, 108°, 135°, 128°, 45°, 55°, 40°, 50°, 60°). The result of the angle degree test may be combined with the node quantity method to develop the measurement.

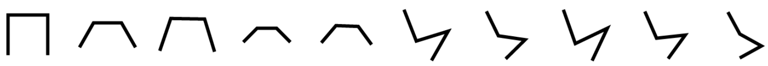


*Figure 11. Angle **selection***

Number of components
The component test assumes that the figure with fewer components tends to be simple. This experiment used the following figures with the same shape and increased the numbers of it by varying transformation. This section can be compared with the previous component quantity experiment.

Figure 12. Component selection

3.1.4 Experimental Procedure

In the experiment observers were presented with seven sets of images in turn. Each set of images contained diagrams from one of the seven factors (form, open-closed, straight-curved, symmetry, weight, numbers of angle and numbers of component). Figure 13(left) shows an example of the images presented to the observers. Images were placed at the bottom left corner of the screen and the images were placed at the red box with a random sequence. The observer instructions were given as below; for each image set, they were asked to complete the following tasks:

1. Put <u>all</u> of the given images in order, from the simplest (1) to the most complicated (10). **Please do not resize the images.*
2. Please drag the images from the <u>left hand side</u> and place them into the numbered boxes.

There was no time limit for the experiment; generally, observers took 10-15 minutes to complete this task. Figure 13(right) shows an example of the observers' results. The observer arranged the ten diagrams in sequence according to their judgement on simplicity. The observers were asked to complete the tasks, following the same instructions for all the seven sets of images.

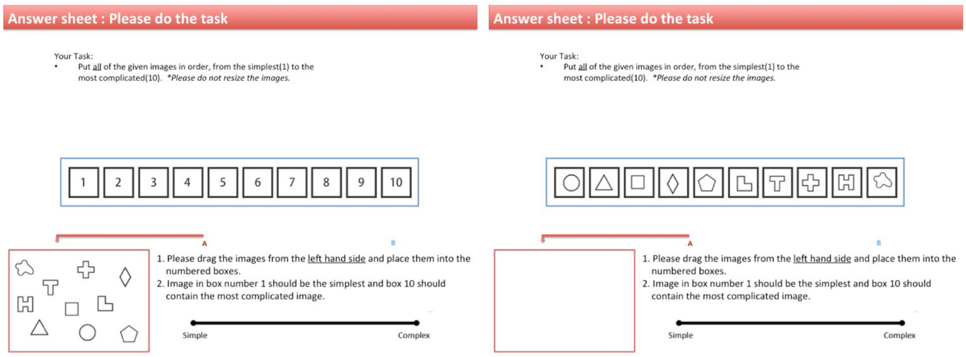


Figure 13. An example of images for Form presented to the observers (left), the observers' results on the factor Form (right).

3.2 Result and analysis

Observers' results were converted to numeric scores. Mean scores (representing the sequence of the factor levels) and standard errors (observers' variability) were computed. In each image the ranking of the diagrams was recorded and the cumulative rank order of each diagram was averaged by the number of observations. Given each element has different levels of simplicity/complexity present, the mean results were all multiplied by a factor to fall into a range of 1-10.

Tables 1-7 show the mean score and standard errors for the simplification task. The results show the average sequence arranged by observers in each section. The sequences of each image are placed according to observers' results illustrated by mean and standard error in the following tables. A number of interesting findings emerged from this experiment. For the form task most of the observers placed the order of simplification from simple to complex images based on the numbers of sides and angles in particular when comparing circle, triangle and square and irregular H-shape. The standard error of form results is between 0.08-0.47. This indicates the consistency of the observers' results, in particular with the circle.

*Table 1. **The result of form***

Mean	1.16	2.58	2.84	4.50	5.63	6.45	7.00	7.92	8.00	8.92
Std error	0.08	0.11	0.11	0.24	0.25	0.22	0.18	0.20	0.47	0.17

For the open-closed task all observers put the completely closed shape as the simpler shape. Apart from the pure closed shape, the result reveals that observers tend to place the angles around +45° or -45° (45° and 255°) as the simpler shape rather than ambiguous angles that are around 180° but not accurate (165° and 195°). The standard error of open-closed results is between 0.00-0.22. This indicates no doubt that the closed shape is the simpler shape with high agreement.

Table 2. The result of open-closed

Mean	1.00	3.03	3.03	3.97	4.16
Std error	0.00	0.22	0.14	0.13	0.19

Thirdly, the results for the straight-curved task show that pure curved and pure straight shapes tend to be simpler than mixed shapes. However, the mean score (1.74, 1.92) and standard error (0.12, 0.16) for both curved and straight shapes are quite close and can be grouped in the same degree of simplicity.

Table 3. The result of straight-curved

Mean	1.74	1.92	2.34
Std error	0.12	0.16	0.08

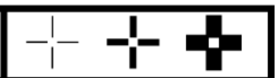
Fourthly, an interesting finding in the symmetry test emerged in this experiment indicating the different types of symmetry with different levels of simplicity influence. Generally, it can be seen that the pure symmetry shape is certainly defined as a simpler shape with mean (1.00) and standard error (0.00). The next one, translation, which could be seen as a copy and move, was placed in the second degree of simplicity with mean (2.55) and standard error (0.18). The reflection symmetry seems equal to complete symmetry and translation and gets a mean score (3.79) and standard error (0.20). However, the degree of rotation and 2-fold rotation were quite similar and seem hard for observers to categorise, remarkably getting a mean score (4.16, 4.29) and standard error (0.20, 0.16). The most complicated shape was predictable — asymmetry placed in this level by observers.

Table 4. The result of symmetry

Mean	1.00	2.55	3.79	4.16	4.29	5.21
Std error	0.00	0.18	0.20	0.20	0.16	0.17

For the weight task, observers generally arranged the images in the order from lighter to heavier or thicker shapes. The standard error of weight results was with the ambiguity possibility (0.06-0.11) that might be considered to require further experiment to clarify. Nevertheless, the result still supports the hypothesis that major observers choose lighter ones as simpler shapes.

Table 5.The result of weight

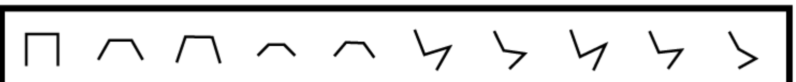


Mean	1.39	1.89	2.71
Std error	0.11	0.06	0.11

The results in the angle task clearly illustrate the relationship between angle size and simplicity. Observers indicated that the images generated by 90° were the most simple shape with high agreement (standard error 0.07). It could be generally classified into four groups (90°, >90°, 45°, <90°). Even though in the over 90° group, there does not seem to exist a particular relationship with angle size due to the order being 120°, 108°, 135° and 128° respectively, the result could still be regarded as the second level of simplicity. The demarcation of simplicity in the angle task can be depicted by 45°, the angles smaller than 90° being placed in the complicated group (55°, 40°, 50°, 60°).

In the degree of angles, 180° was given the score 0 because 180° could possibly be a circle and a line without any angles. The second size of angle 90° was given the score 1.16 and the angle between 90°-180° was scored as 4.55, the angle 45° got 6.87 and the angle between 45°-90° got a score of 8.13.

Table 6.The result of angle



Mean	1.16	2.76	3.53	4.55	4.79	6.87	7.63	7.74	7.84	8.13
Std error	0.07	0.31	0.19	0.25	0.24	0.33	0.24	0.36	0.26	0.27

The result of the component task reveals that observers placed the order according to the number of shapes which were obtained for one, two, three, four and five components respectively. The average score increased steadily from fewer components to more components in the image. High agreement in this task was where there were fewer components, the image tended to be simpler. The majority of the observers indicated that five components was the most complicated image with a mean score 5.00 and standard error 0.00. The standard error in this task is around 0.00-0.10 which is the clearest principle in these seven tasks for defining the degree of simplicity.

Table 7. The result of component

					
Mean	1.26	1.89	3.05	3.79	5.00
Std error	0.10	0.08	0.06	0.09	0.00

According to the results, a template for simplicity measurement for each factor has been created and is shown in the tables above. Not surprisingly, in the result of form, circle, triangle and rectangle are in the simplest order. An interesting finding in this result is that observers might also consider the numbers of angle with form simplicity selection started from no angle (circle), three angles (triangle), four angles (square and diamond) and more than five angles (polygon, etc.) respectively. However, the irregular shape is placed ninth which might be an ambiguous and unexpected result compared to the most complex one — H-shape. One possibility might be the number of sharp angles. Open-closed elements could be understood as two categories — over 180° and under 180° — that the former one tends to be defined as a simpler shape and the latter tends to be the least simple. The result of straight-curved, symmetry, component and weight almost match the hypotheses, and the data shows a clearer statistic about the distance between each level. The most interesting finding is that the degree of angles results suggest that sharper angles tend to be seen as the least simple shape and the flat one tend to be seen as simpler shape. The template summarises the results of each level of the elements.

4 CONCLUSIONS

A review of simplicity analysis criteria is given in this study. Taken together, this study provides good evidence that rule of simplicity exists which could be helpful for further research - simplification measurement. The initial concept of this study was looking for an appropriate simplicity method to enhance logo recognition ability. The result of this experiment evaluates some possible factors that might be influencing simplicity decision. This result suggests a more systematic method to evaluate the level of simplicity. The paper presents summarised results from 40 observations and has been found agreement with six of the seven simplification hypotheses. Simplicity in shape analysis could be defined as (1) regular form; (2) shapes with closed outline; (3) shapes with pure straight and pure curved form; (4) symmetrical shape; (5) the shape with lighter superficial measurement; (6) angles in the shape over 180° and (7) fewer components. The results of this study indicate that it is feasible to develop a systematic measurement for scoring the degree of simplicity.

The initial recommendation in practical work such as logo design would suggest reference to the seven factors mentioned above in this study to evaluate the recognition risk before finalising design. Further research could focus on more details of shape or contour characteristics and the inside content of shape rather than shape outlines. The understanding of simplicity might be helpful for shape analysis and characteristics that could extend to broader applications such as image analysis. In addition, it plays an important role in object recognition and image-matching techniques.

However, this study assumes each of the seven elements are equally important in the measurement which is one of the limitations. The hypotheses and result of this experiment provide the possible factors of simplicity decisions but the proportion of influence of each factor has not yet been found. Further work will consider the relative importance of the elements and should be factored into the template. The result of this experiment aims to provide a reliable and systematic measurement for logo recognition development in different media display; furthermore, it could enhance recognition ability and offer a pre-measurement test before the direction signs and other works are printed.

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