

# How Experts and Novices Perceive the Photographic Image Composition: An Eye-Tracking Study on Composition

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**Abstract.** Many camera industries start to integrate artificial intelligence into their products in order to help novice users shooting photographs like experts. One of the differences between novices and experts is the knowledge and skill of image composition. This study sought to emphasize find out how the rule of thirds and leading lines are effective to guide to images' focal points. 30 participants, 15 with photography education (Experts) and 15 without (Novices), were tested with similar images by using the eye tracking device. They were measured in terms of total dwell time and attention by the area of interests (AOI) to compare the heatmap between the expert and novice participants. The result shows that the experts chose the images with rules of third more often while the novices chose other elements over the composition. This study shows an insight that 'Rules of third' does not necessarily make photographs look more appealing to novices' eyes; however, it helps images become more interesting for experts. For the leading lines, both experts and novices did not follow the Loomis's suggestion for entering, exploring, and exiting.

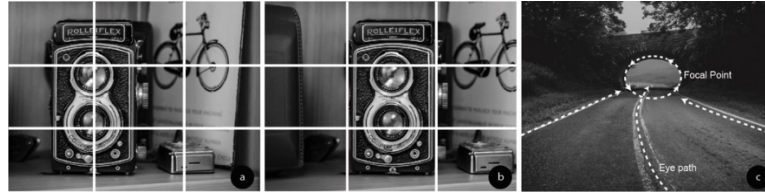
**Keywords:** Eye Tracking · Usability Research · Composition · Leading Lines · Human Factors

## 1 Introduction

Photography Composition is how the elements of a photo are arranged. Photo composition can be made up of many different elements, or only a few. It is how the photographers put those things within a frame to help photographs become more or less interesting to viewers. There are several composition techniques such as rules of thirds, centered composition and symmetry, foreground interest and depth, leading lines, a frame within the frame, diagonals and triangles, and others. A good composition should not only be pleasing to viewers but should ensure that their eyes are guided to the image which is the most important for understanding it [1].

Understanding the decision making and attention underlying experts and novices is of significant importance in the human factor. In this study, the assumption on photography techniques is still questioning. The experts may not follow the rules and use their intuition to judge whether their photograph image is right or not. The main objective of

this study is on the rule of thirds and leading lines which are the most used techniques in the field of photography.



**Fig. 1.** Examples of photographs analyzed in the present study. (a) Photograph that follows the rule of thirds. The main focal object is on the line. (b) Photograph that does not follow the rules of thirds. The main focal object is not on the line. (c) Photograph that follows the leading lines.

### 1.1 Rule of Thirds

Smith [2] claimed that the rule of thirds represents a more harmonizing proportion to follow in paintings of rural scenery than any other proportion. It is the most important composition rules used in painting and photography [3, 4] Figures 1a and 1b show that the focal object should be placed along with one of the two imaginary horizontals or the two imaginary vertical lines that divide the image into nine equal parts [5]. Several research studies are on computer-based or machine learning with the rule of thirds by using the saliency map [5, 4]. Nevertheless, there is no study on how experts and novices perform differently on the rules of thirds. The focal objects might draw the attention of both experts and novices so they cannot decide which images are of the rule of thirds. In this study, the aim is to investigate how experts use their decision making to judge images without informing them which one follows the rules of thirds by comparing with novices' decision making.

### 1.2 Leading Lines

Leading lines are lines that appear in a photograph that has been framed and positioned by the photographer to draw the viewer's eye towards a specific point of interest (see Fig.1c) Kirtley [1] experimented with the leading lines on the line art images and checked whether participants followed the pathway of Loomis' images [7]. The result shows that participants did not strictly follow Loomis's suggestion for entering, exploring, and exiting. However, they were still drawn to the focal point of each image and spent a long time. In this study, the investigation is how experts' and novices' scan paths are the same or different.

## 2 Method

### 2.1 Participants

Thirty participants with experts (15) and novices (15) with a mean age of 26.5 were recruited from the office building. 17 out of 30 were male. The experts had their experience of shooting photos at least for few years and took at least one photography class

at their undergraduate level. They graduated in many design fields such as Industrial Design, Architecture, and Communication Design. The novices had neither experience in photo shooting nor taking any photography class. They graduated in the fields of business and management.

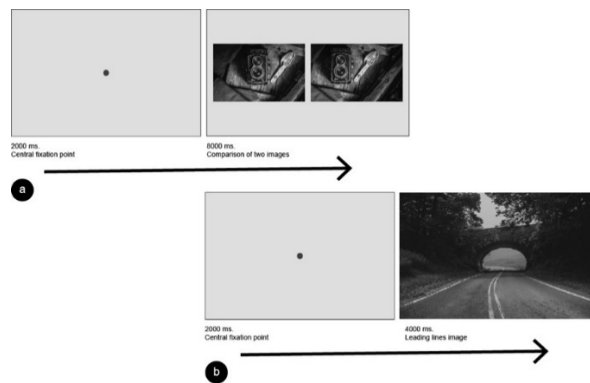
## 2.2 Stimuli and Apparatus

**Rule of thirds.** The experimental images used were 15 pairs of photographs. These images were 1680x1050 pixels. They consisted of images cropped differently to create a rule of thirds and non-rule of thirds and were placed side by side. All of them were pictures of objects in order to avoid the emotional feeling that could draw attention. The questionnaire of 5-point Likert Scale was used to confirm whether participants select the rule of thirds or non-rule of thirds.

**Leading lines.** The experimental images were 10 photographic images. All of the images were the scenery with the leading line that took the attention of participants to the focal point. The leading lines were the combination of straight and curve. Some of the leading lines pointed to the object such as bamboo trees and houses. Some of them pointed to empty space.

**Eye tracking.** Participants' eye movements were monitored and recorded on the SMI iView X RED 4 (sampling frequency 100 HZ) for both eyes with a 9-point automatic calibration grid with the chin rest.

## 2.3 Procedure



**Fig. 2.** Diagram of the study procedure. a) Non-rule of thirds and rule of thirds images. b) leading lines images.

**Rule of Third.** The rule of third images were collected from unsplash.com and edited with the Adobe Photoshop with the function of content-awareness fill workspace. The images were extended and cropped. Participants were assigned to watch the central fixation point (cursor) around 2,000 ms then the stimuli of rule of thirds and non-rule of

thirds presenting 8,000 ms side by side (see Fig.2). Participants were informed to decide which images they would select. They then stayed on that picture until the change for the next stimulus.

**Leading lines.** For the leading lines, the central fixation triggered around 2,000 ms. The leading lines image presented 4,000 ms.

For the whole testing, the subjects spent time for 15 minutes including the questionnaire doing.

## 2.4 Analysis



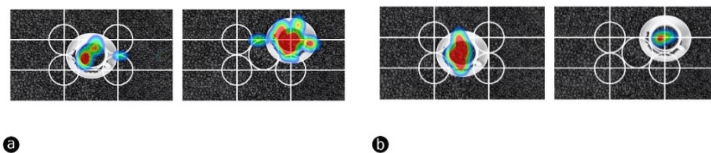
**Fig. 3.** Example of scan-path analysis showing two scan-paths over grid types, and how the grid layout affects the letter sequence describing the path.

**Rule of Thirds.** The eye tracking data was analyzed by using the heat map and total dwelling time on overall Area of Interest, and then using an independent sample-test on the PSPP statistical analysis software.

**Leading lines.** The analysis of leading lines was applied the use of the scan-path analysis with an overlay 6 x 6 grid (see Fig. 3). On the layout, the letter sequence was used to describe the paths. Then the Levenshtein distance [8] was created between two strings.

## 3 Results

### 3.1 Rule of Thirds



**Fig. 4.** Heat map of average Area of Interest (AOI) on the cup of coffee. From the Fig. 4a, the heatmap shows that experts spent time on the rule of thirds (left) than the non-rule of thirds (right). From the Fig. 4b, the heatmap of novices shows they preferred the non-rule of thirds (right) than the experts (left).

The heat map shows that expert participants spent their time on the rules of thirds more than novices (see Fig. 4) Expert subjects mostly looked at the areas near the four spots of the rules of thirds, and their eye movements were more in smaller areas. The average time that experts spent on the rule of thirds was 68,250 ms over non-rule of thirds (38,556 ms). On the other hand, novices spent average time on the non-rule of thirds around 57,679 ms, compared to that of the rule of thirds images (47,554 ms). In summary, experts selected the images of the rule of thirds with the number of 11 from 15 images while novices selected 8 from 15 images. Experts had a clearer judgment on the images that followed the rule of thirds, while novices randomly selected images based on their intuition.

An independent sample t-test was conducted to compare whether experts selected the rule of thirds or non-rule of thirds. There was a significant difference between rule of thirds ( $M=58,372$ ,  $SD=12,305$ ) and non-rule of thirds ( $M= 43,948$ ,  $SD= 11,379$ );  $t(28)=3.33$ ,  $p =0.02$ . For novices, there was no significant difference between rule of thirds ( $M=52,2249$ ,  $SD=17530$ ) and non-rule of thirds ( $M=49,383$ ,  $SD=16803$ );  $t(28)=0.46$ ,  $p=0.651$ . Subjects might select the images based on other influencing elements in their decision-making process than just the rule of thirds composition. Their eye movements scattered more around the frame compared to experts. Even their questionnaire results show that novices judged the image based on their intuition rather than knowledge.

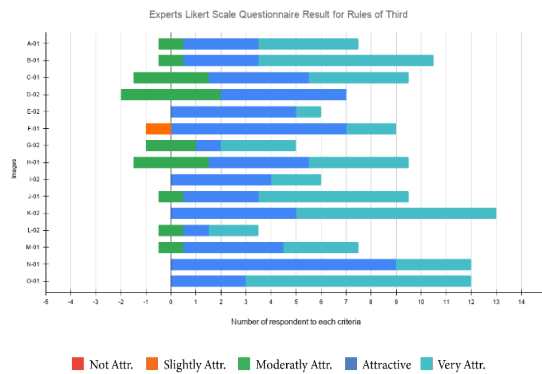


Fig. 5. Experts' Likert Scale Questionnaire for Rule of Thirds.

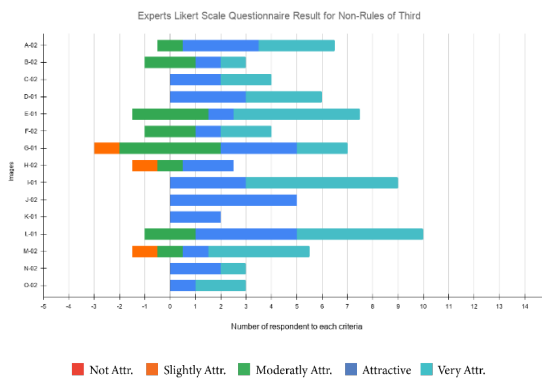


Fig. 6. Experts' Likert Scale Questionnaire for Non-Rule of Thirds.

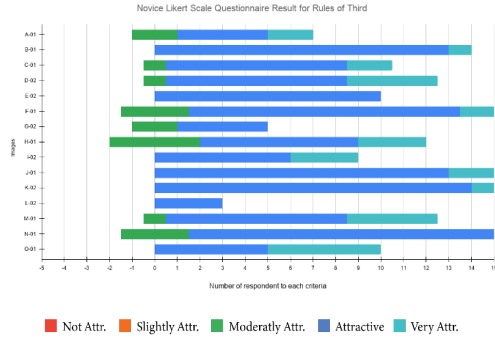


Fig. 7. Novices' Likert Scale Questionnaire for Rule of Thirds.

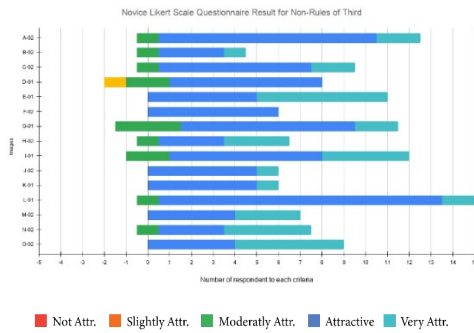


Fig. 8. Novices' Likert Scale Questionnaire for Non-Rule of Thirds.

The results were similar for the questionnaire. Experts gave a very high attractive score of satisfaction on the rule of thirds (see Fig. 5) around 38.67% than the non-rule of thirds around 24.00% (see Fig. 6). On the other hand, novices gave very high attractive scores on the rules of third around 21.33% (see Fig.7) and the non-rule of third equally around 24.67% (see Fig. 8). The results show that novices could not distinguish the attractiveness between the rule of thirds and non-rule of thirds.

### 3.2 Leading Lines

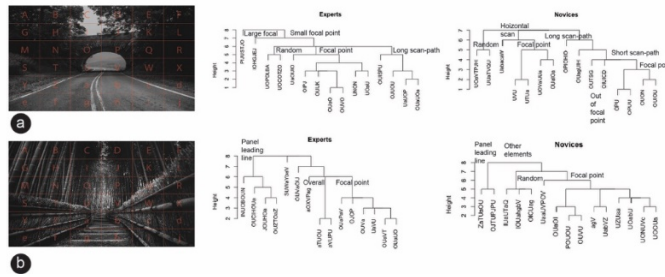


Fig. 10. Example of scan-path and cluster dendrogram. a) Less leading lines b) A lot of leading lines and surrounding components.

For analyzing the experts and novices' scan-path, we conducted a string-edit method to compare paths taken by participants (see Fig.10). The dendrogram shows the patterns of scan-path of each participant with the alphabet on the grid. They were grouped with Levenshtein distance. The results show that both experts and novices did not follow the Loomis's leading lines. On the other hand, they started from the focal and looked backward direction to the outside. Both experts and novice did not follow the Loomis's suggestion for entering, exploring, and exiting. The visual scan-path was shortened than normal. Figure 10b tends to have a longer path than Figure 10a. Moreover, the side panel leading line (bamboo fences) affected the way participants looked forward to the focal point. The surrounded components such as the bamboo tree also distracted the focal point as well. The more picture components exist, the more scan-path will appear. In conclusion, the leading lines cannot be used to distinguish between experts and novices.

## 4 Discussion

The current study examined how the composition of photography could guide the eyes of the participants into the image. Similar to the Kirtley's result [1], participants focused on the most important (focal) point of an image without following the path of the starting point of the path. One of the shortcomings was the central fixation point might lead the participants' eye to the center of the image. As a result, many experts did not start looking from the starting point below the picture. There have been some suggestions of entering point from top left corners for an image base on how people navigate comics [9], but as Cohen's notes, "Comic pages have an intended reading order" (P.8). Therefore, the experience of reading a comic might be different from looking at an image. The top left corner entering suggestion might have a strong fluence based on westerner's reading habits. The finding shows that participants entered the image based on their first saccade and approached the image center on their second saccade since the fixation point was placed in the center in this study. Nonetheless, this could be a replica of a real-world experience when someone is approaching an art frame in a gallery, either from left to right or straight, they might start to enter the image from their nearest points. Also, this study shows that no matter how the elements are distributed within the frame; still, the participants would only observe mostly the central part of the image rather than the whole frame or even follow the leading lines patch. The study also [10] shows evidence of this behavior.

Participants explored the images in a different sequence than the suggested path created by leading lines in images. This is not surprising since also in the rule of thirds study, participants tend to just observe the important parts of an image (Focal points) than scanning the whole image.

As previous studies by Leder et al. [11], the model of aesthetic experience also proves that some other external elements would affect the way people look at an image. The analysis of an image starts at an early stage of viewing but still is influenced by factors even before the viewing occurs. Those include contexts within the image, image classification based on participants' interest, and image elements during the viewing such as previous experiences and memories, as well as the emotional and personal state of participants. All of these would influence their judgment and physical inspection of

the images. Thus, compositional suggestions such as those we examined can only ever account for a part of the observer's viewing behaviors.

This study shows similarities to those previously done; for instance, most people have the tendency to attract to the focal points more than other elements that lead them to the focal points.

One of the most appealing results from this study is that educational background has a high impact on the experts' decision-making process. The outcome shows that other photographic elements influence novices than the compositional reasons to select one image over others. Another interesting finding is that the rule of thirds image can be used to distinguish between experts and novices' skills.

This research can be applied for machine learning but is needed to consider other variables that affect the rule of thirds such as the amount of AOI used in rule of thirds regions. Machine learning can help novices to take photographs correctly according to the study. From the result of the leading line, some photography composition techniques may be certainly for machine learning while some may not. As a result, the study of other composition techniques are still required.

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