Gestalt Perception For Decomposition of Images

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Abstract

Gestalt Theory and Laws are well studied in the past since its origin. But they are not much studied with the help of eye gaze tacking system. My project is on studing how people decompose a given image into its parts. I have also used eye gaze tracking system to track their saccadic movement and fixation of the eye. This helped me to analyse thier decomposition and predict the possible reasons for a perticular decomposition.

Introduction

Gestalt Theory explains how we percieve or organize the patterns we come across in our daily life. The visual scenes that we percieve are composed of many different types of complex patterns and shapes. We try to group these patterns in a whole instead of pereiving as many different parts. This theory was first introduced by Wertheimer (1923/1938) and was further developed by Köhler (1929), Metzger (1936/2006), Koffka (1935).

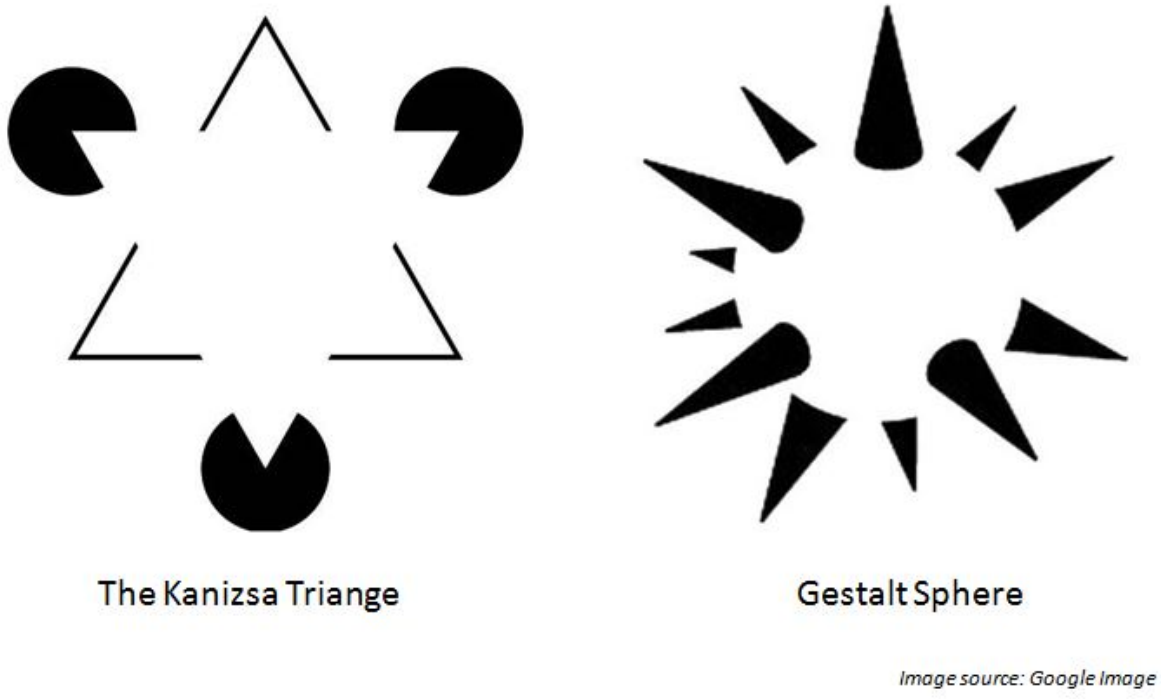

Figure 1: We perceive the these images as whole and see a triangle and a sphere.

The Gestalt Theory has been widely studied and today it is described by mainly six rules or factors: Proximity, Continuity, Similarity, Symmetry, Closure, Common Fate(or common motion). These rules are used in Computer

Vision to design a computational models to solve various vision problems. They can also facilitate machines to percieve the world as we humans do.

Motivation

In this project I have studied how people give importance to the rules defined above to perceive a perticular image and how they decompose it into its parts. Analysing the decomposition of an image into its parts can be helpful as we can infer how they group the image by seeing the decomposition. I have also used the eye gaze tracking system to track the saccadic movement of the gaze of the subjects. This can be very useful by facilating my analysis of the decomposition of an image.

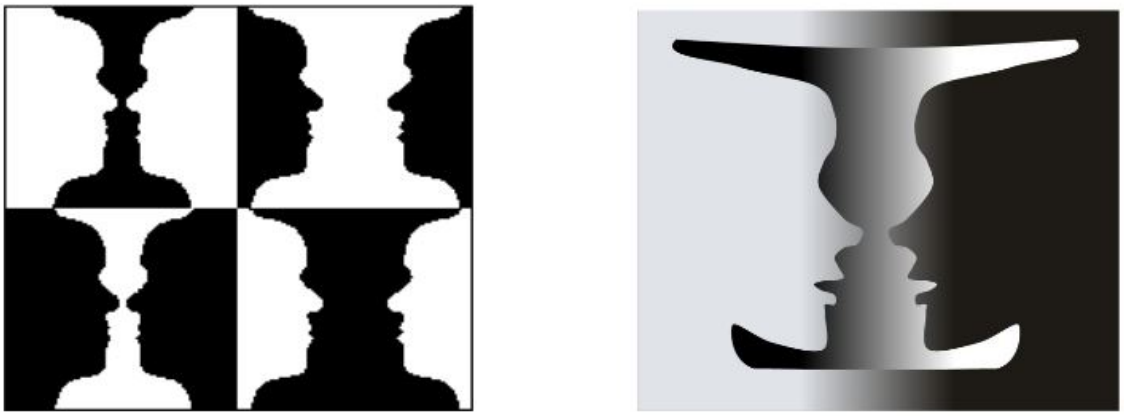

Figure 2: In the left figure, we decompose the four different rubin vases into different ways. Varing the contrast and the width of the vase results in the different perception of figure and ground. Image Source: Google Image

Since the Gestalt Theory is not well studied by this methodology (i.e by the help of eye gaze tracing system), this acted as a motivation for me to try a new way of studing the gestalt perception.

Experiment

The image set that has been used for the experiment are not contained by complex images but simple and regular figures that we see in our daily life. The simple logic that 'complex images can make the analysis complex too' acted the reason for this type of image selection. These images were made in MS Word.

There were total 14 subjects out of which 4 were asked to observe the 10 images for 5 seconds each and their eye gaze was recorded. Other 10 subjects were again asked to observe modified 10 images for 5 seconds each and draw the decomposition of these images. Their eye gaze was also recorded. The first 4 subjects were useful for recieveing the feedback on the images. This feedback lead to the many new and interesting images which were later shown

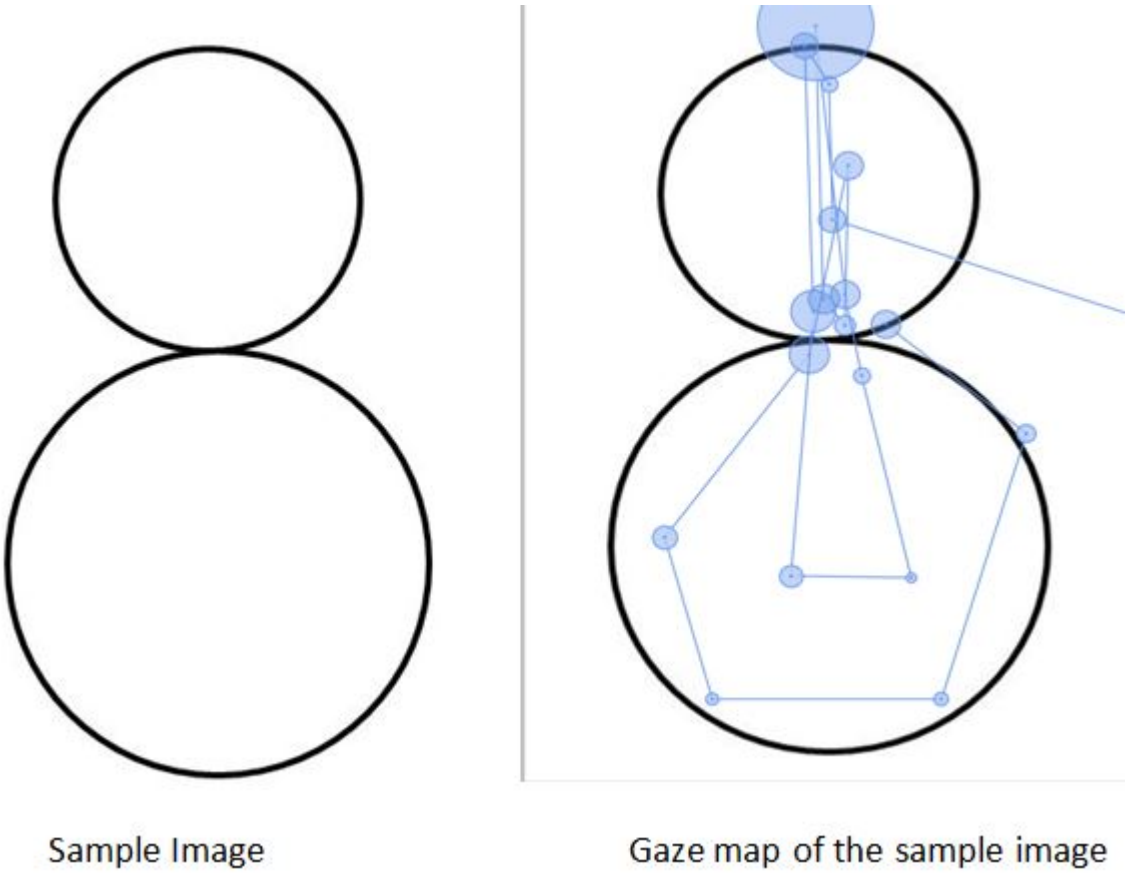

Figure 3: The sample image used in the experiment and the gaze map of the same image.

to next 10 subjects. Each subject was provided with paper and pencil which they used to draw the decomposition after seeing a perticular image.

Results

Interesting results came from the experiment. In many cases eye gaze tracked images were helpful to predict why subjects choosed a perticular decomposition. Some of these interesting result are explained below.

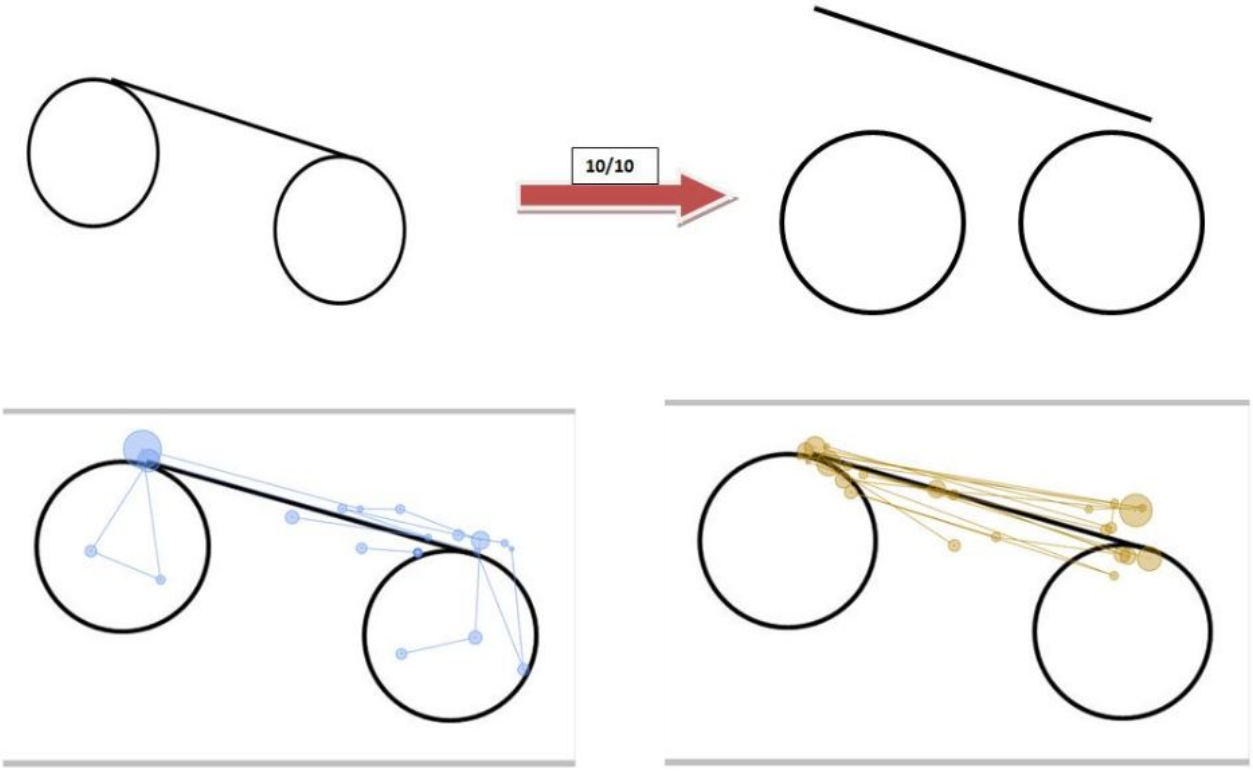

Figure 4: Top left: original image used in the experiment. Top right: decomposed image by the subjects. Bottom: gaze map of two different subjects.

In the above figure(top left), subjects are mostly focusing on the line joining the two circles. This can be concluded from the gaze map shown in the above figure. All the 10 subjects decomposed the image into same way shown in the above figure(top right).

In the figure 5, the rule of continuty plus the rule of similarity of color dominated the rule of similarity of the shapes(circles). This was the reason why each subject decomposed it into two 'S' like figure. From the eye gaze map, we can see that the intersection of the two colors and the change of color is mostly focused.

Figure 6: In this case, 9 of the subjects have decomposed it into a same way and only one has decomposed in to different way. Since there are many circles in the image, most of them decomposed it into three circles. Subjects have mainly focused on the occluded part of the images. The one who have tried to decompose into different way have focused more on the most occluded part. This may have made him to decompose in the odd way.

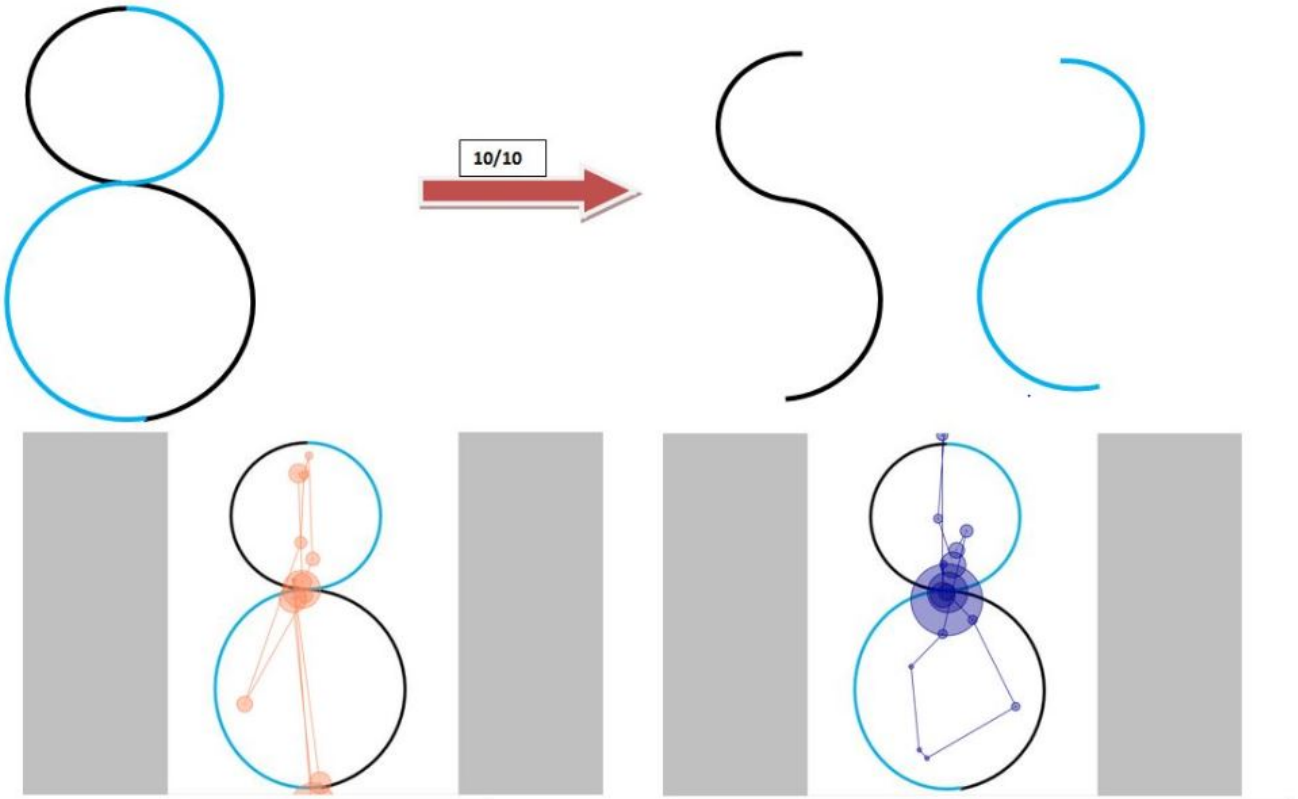

Figure 5: Top left: original image used in the experiment. Top right: decomposed image by the subjects. Bottom: gaze map of two different subjects.

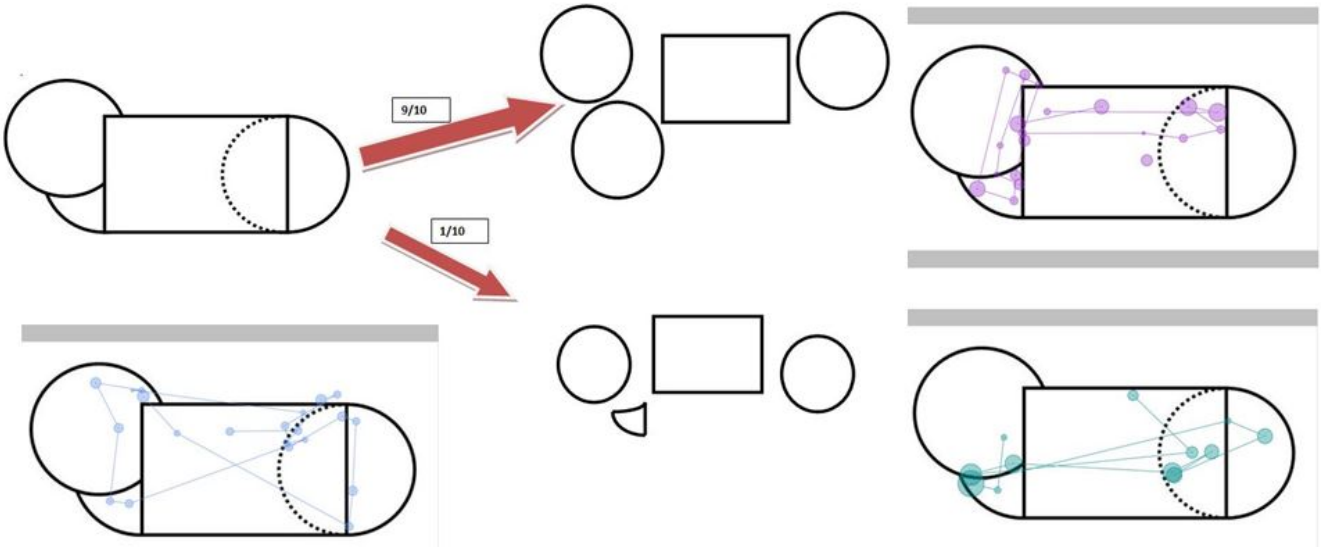

Figure 6: Top left: original image used in the experiment. Middle: decomposed image by the subjects. Right: gaze map of the corresponding decomposition.

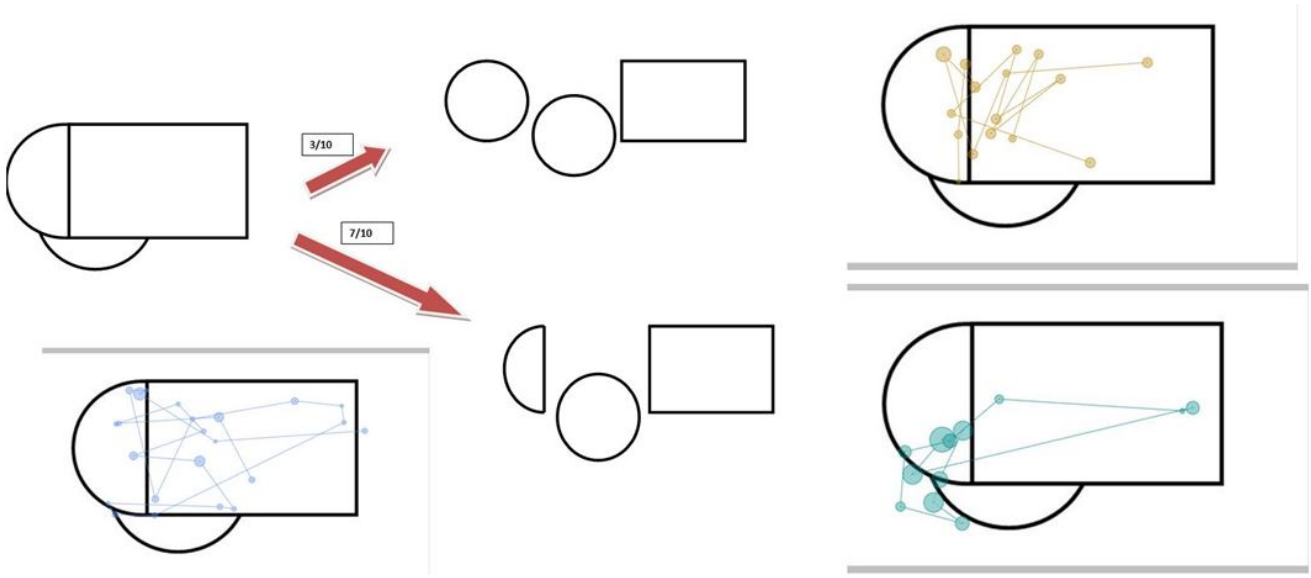

Figure 7: Top left: original image used in the experiment. Middle: decomposed image by the subjects. Right: gaze map of the corresponding decomposition.

Figure 7, here in the original image we can see that the left most part of the image is not semi-circle. From the gaze data we can say the that the subjects who have tried to focus ob the left most part of the image have decomposed it into a circle. Whereas the subjects who have focused on lower part of the figure have decomposed the left part as a semi-circle. Here subjects got busy in predicting the lower 'not so common' image and ignored the left image.

Figure 8: Here the three triangles are placed very close to nearly generate a new triangle. But all of the subjects have drawn the decomposition into three triangles. From the gaze data, we can predict that subjects have mainly focused on the joining of the three triangles and have ignored the center triangle. Here the figure was too simple for bringing the closure property into account.

In the Figure 9, we can brought the three triangles to touch each other. So most of the subjects have decomposed it into four triangles. But four subjects have decomposed it into a big triangle and small triangle as if the bigger triangle is a 'ground' and the smaller triangle is a 'figure'. The reason for this decomposition can be the fact that they have imagined that the three triangles of the previous figure are brought closer to form a new triangle. So they focused on this new triangle which resulted them to see it as a figure and rest as ground.

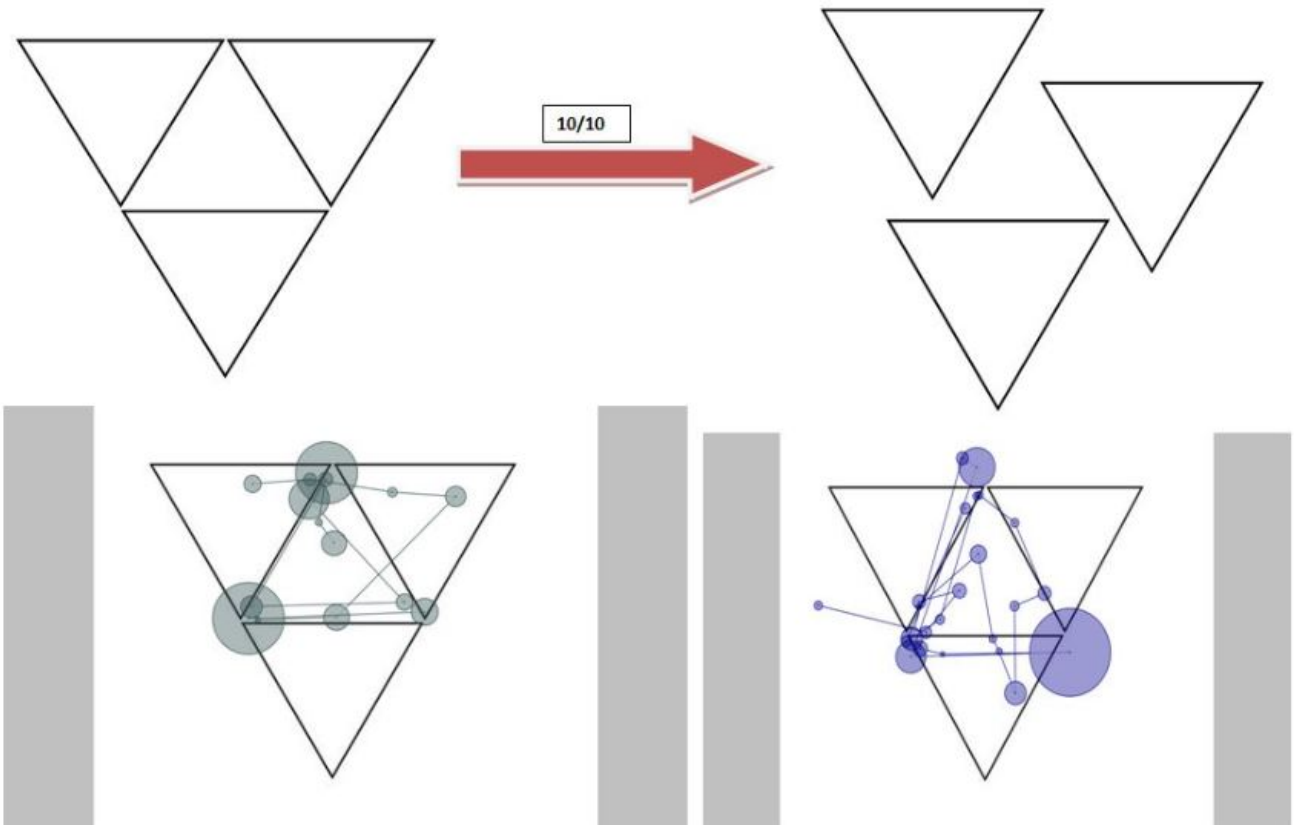

Figure 8: Top left: original image used in the experiment. Top right: decomposed image by the subjects. Bottom: gaze map of two different subjects.

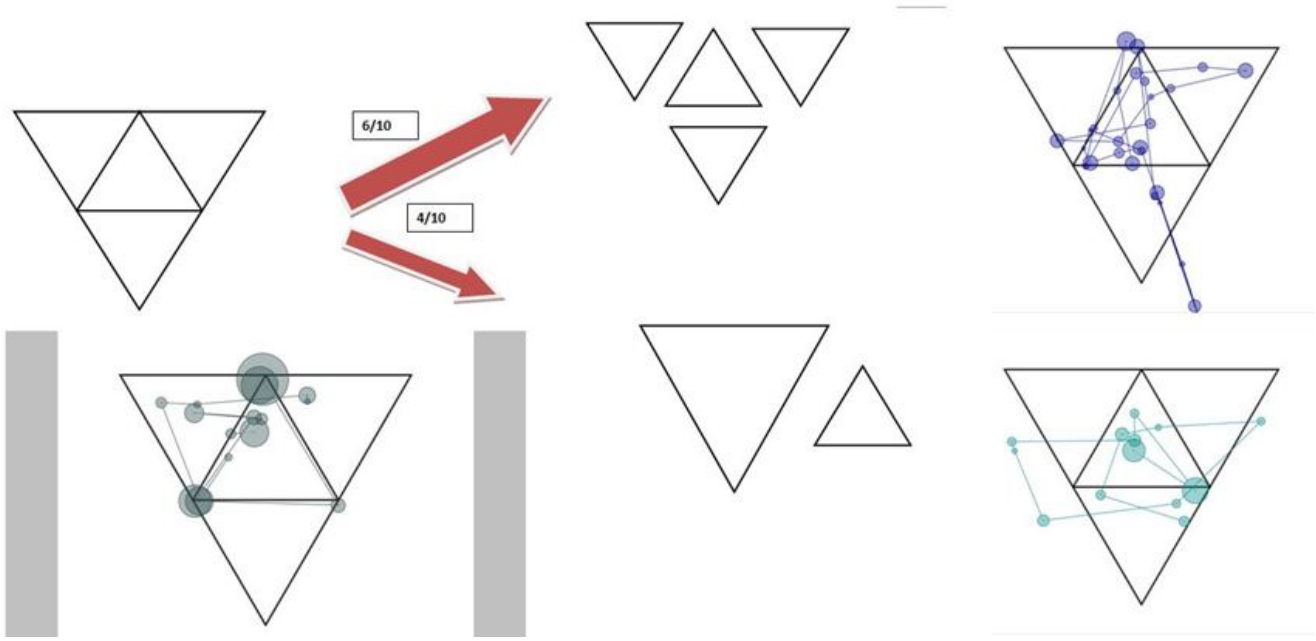

Figure 9: Top left: original image used in the experiment. Middle: decomposed image by the subjects. Right: gaze map of the corresponding decomposition.

Conclusion and Future Work

It was hard to give a concrete conclusion form the experiment but few points were seen while analysing the results. Different Gestalt laws were dominant in different figures. While sometimes few weake laws combined overrule the stronger laws such as continuty + similarity of color dominated the rule of similarity of shape. In some of the cases eye gaze tracking was very useful to explain the decomposition.

This eye gaze tracked data can be used to predict decomposion of a figure in the eye gaze tracked image. For this a classifier can be build in computation model to predict the decomposition of the figure.

References

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[5] Image data is self made by Microsoft Word.

Acknowledgements

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