VISUAL COMMUNICATION GROUP F

VISCOM END-TERM PROJECT

Objective :

The aim of the project is to collect data of eye-fixations of different people on some predefined images which are based on interaction of basic colors with main areas of focus on a square white background.

Introduction :

This project uses an Eye-tracker and the relevant software to handle the data recorded by the eye-tracker. Basically the eye-tracker tracks the eye-movement of the person looking at the screen and also measures the time for which the person looked at a particular point. The approach is to show a set of test images to a number of people, obtain the relevant data from eye tracker, analyse that data using RStudio and generate relevant graphs and pie charts.

Eye tracker:

The project requires use of an external eye tracking device. For this purpose, **Tobii Eye Tracker** was used which could detect eye-fixation details for different users by use of Tobii Eye Tracker SDK. Calibration for different user can be easily done by 'Guest Calibration' in this SDK and thus data can be stored and analysed as per the needs.

SOFTWARE USED

I. OpenCV :

OpenCV (*Open Source Computer Vision*) is a library of programming functions mainly aimed at real-time computer vision. OpenCV library was used for generating images required for project and image processing.

II. Microsoft **Visual Studio :**

Microsoft **Visual Studio** is an integrated development environment (IDE) from Microsoft. Computer application for recording data of different responses of persons towards viewing images which were generated using OpenCV was built with the help of Visual Studio along with **Tobii Eye-Tracker SDK**.

III. Tobii Eye-Tracker SDK :

Tobii Eye-Tracker SDK is a free software development kit for easy and efficient development of analytical applications to work with screen-based eye trackers from Tobii. This, along with Visual Studio was used to build computer application for recording data.

IV. Rstudio :

Rstudio was also used for data analysis purpose, and bash, vim and basic c/cpp programs were also used for the purpose of cleaning the data. (*I feel that the step-'cleaning/formatting of data obtained' must also be mentioned since it was time consuming and is also one of the essential step in data analysis.)

APPROACH:

This is how the problem was approached :-

1) A set of test images were created.
2) Data was collected from n number of people using eye tracker. This data includes coordinates of the points and the elapsed time for which a person focused on that point.
3) Collected data was then analysed and on the basis of that analysis various graphs, pie charts, heat maps and gaze traces were generated.

Image Creation:

The images consist of 5 different colours placed at 5 different areas in an image with a white background.

The image was divided into 5 different focus areas: Top-right corner,Top-left corner,Bottom-left corner,Bottom-right corner and a central area. These focus areas were chosen because it allows to compensate for the inaccuracies of the eye-tracker while tracking the eye movements of the user and also it helps us to find the general visual patterns in the population while minimising the error to the maximum extent.

The 5 different colours consist of 3 primary colours (Red,Blue and Green) and 2 secondary colours-Orange and Yellow. The 3 primary colours were chosen because they are the most abundantly occurring colours in nature and other colours are formed using them. The other two colours were chosen from secondary colours to form a total of 5 different colours. Since we created every possible combination of image possible by permuting the areas and colours, from using 5 different colours we create a total of 5!=120 different images and collect data for each image. This puts a limitation on the different colours we can use as for more colours the amount of data which need to be collected becomes too high.

Data Collection:

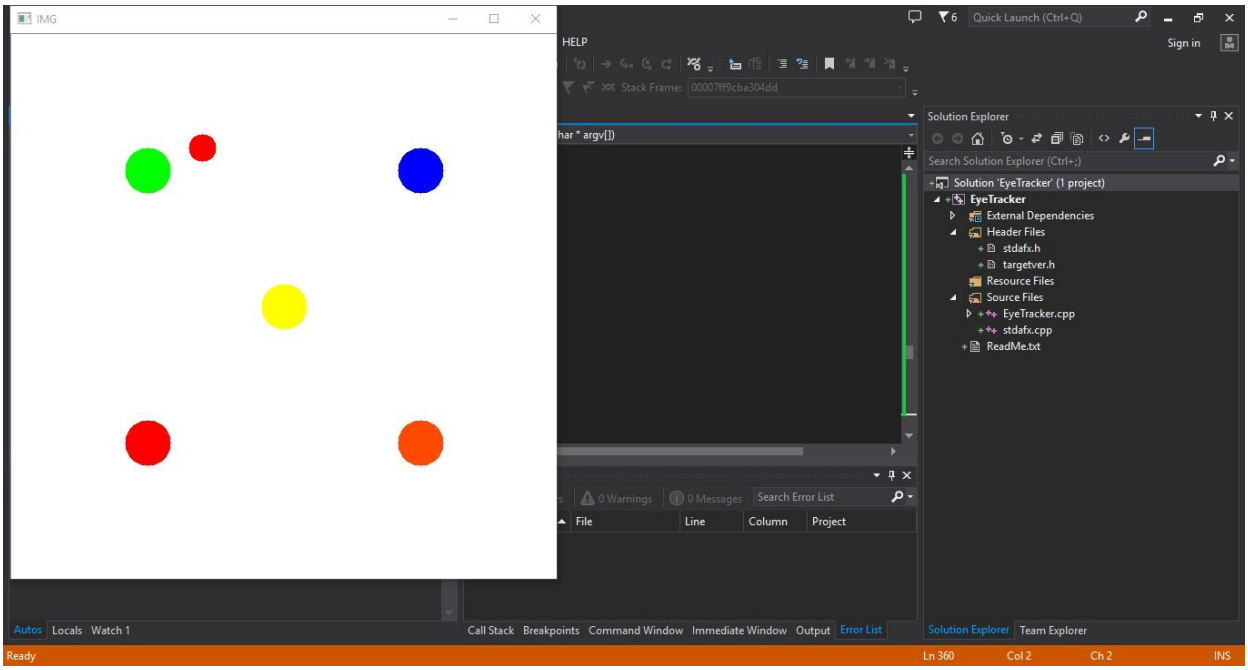
A total of 5!=120 images were used to collect data. Since showing a total of 120 images to an individual is not desirable, the 120 images were randomly divided into 4 groups of 30 images each. The images were then shown to people in slides where each image was shown for a period of 3 seconds and the eye-movements of the user were determined and stored in a csv file. The image was then followed by a pitch-black screen for a period of 1 sec to reduce the effect which the viewing of the earlier image may have on the viewing of the next image so that each image feels as if it is the first image viewed by the person.

The size of the test population is 100 people which means that each image has been viewed by a total of 25 people. The data was collected the form of x-y coordinates and the amount of time for which the eye of the person was fixated at that x-y coordinate.

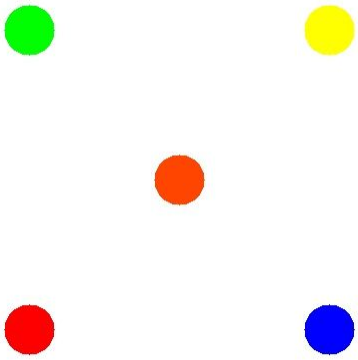
Analysis Methods:

Readings were recorded and analysed using R programming. On the basis of this analysis various graphs were generated that illustrated the relation between focus time and colour for each position and the relation between focus time and position for each colour. Pie charts were also generated that illustrated the relation between colour and the time for which people focused on that colour. Similarly the relation between position and the time for which people focused on that position was also illustrated by pie charts.

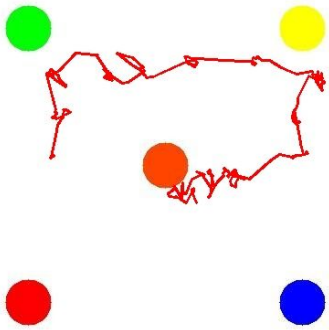
SAMPLE WORKING :



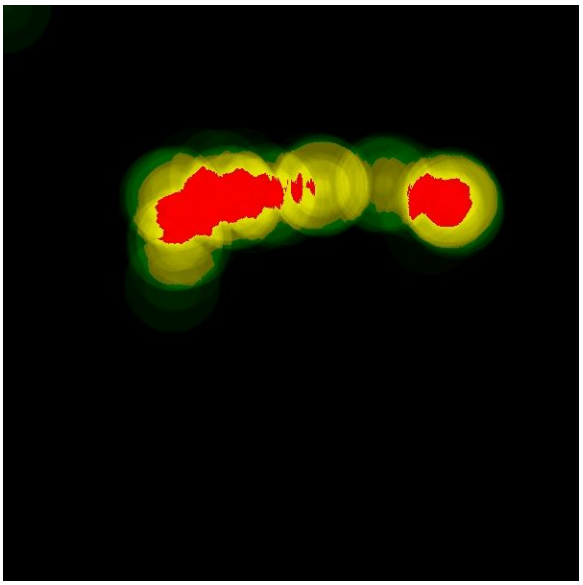
SAMPLE OUTPUTS :



Sample Image

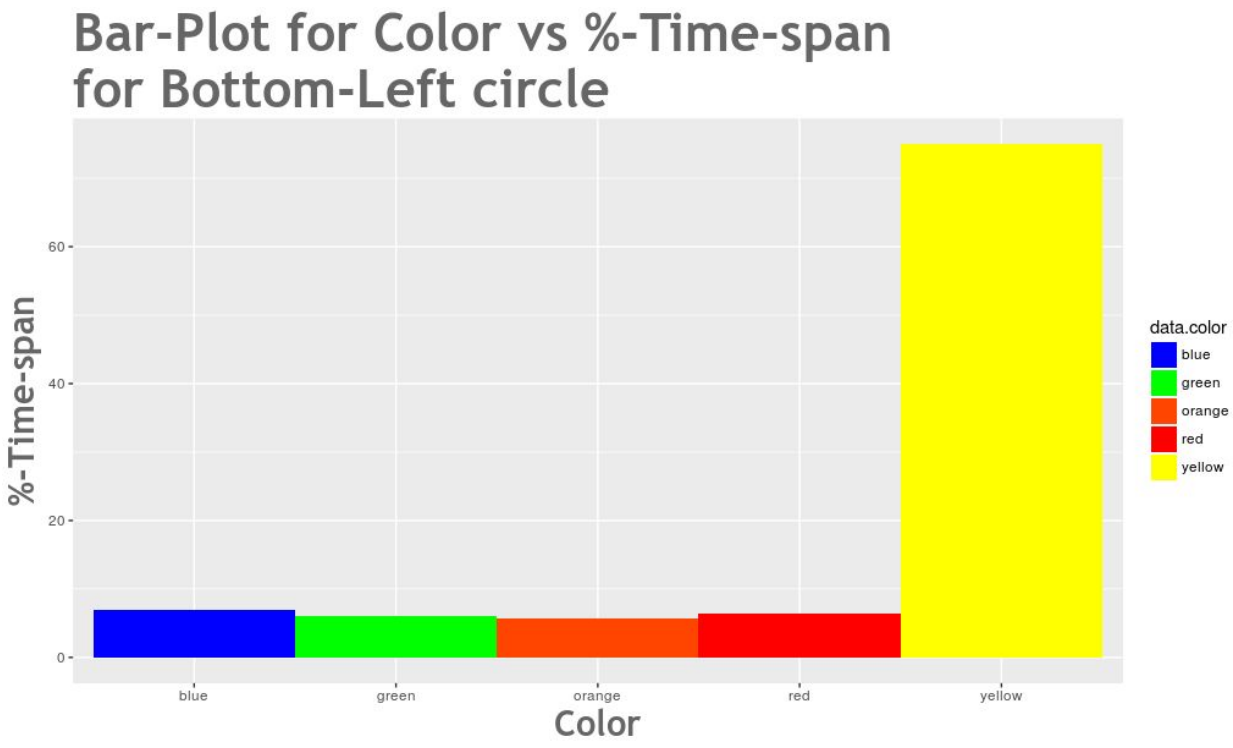


Gaze trace



Heat Map

COMPLETE ANALYSIS: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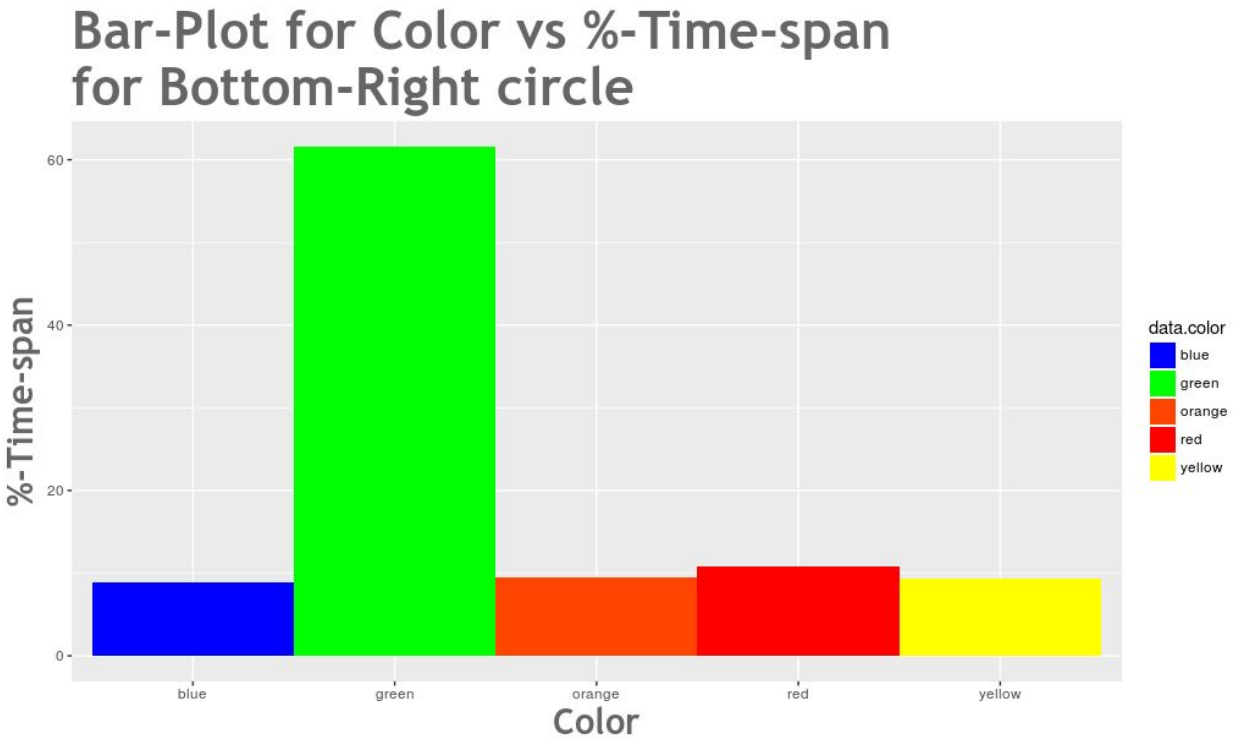
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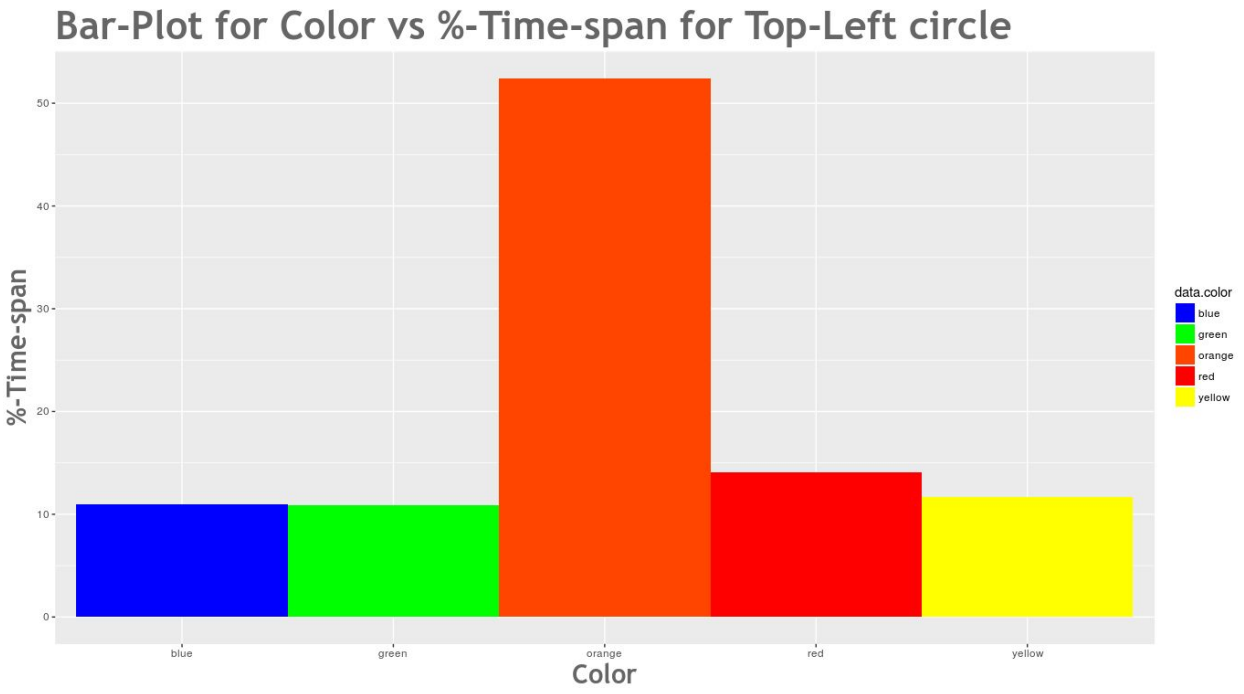
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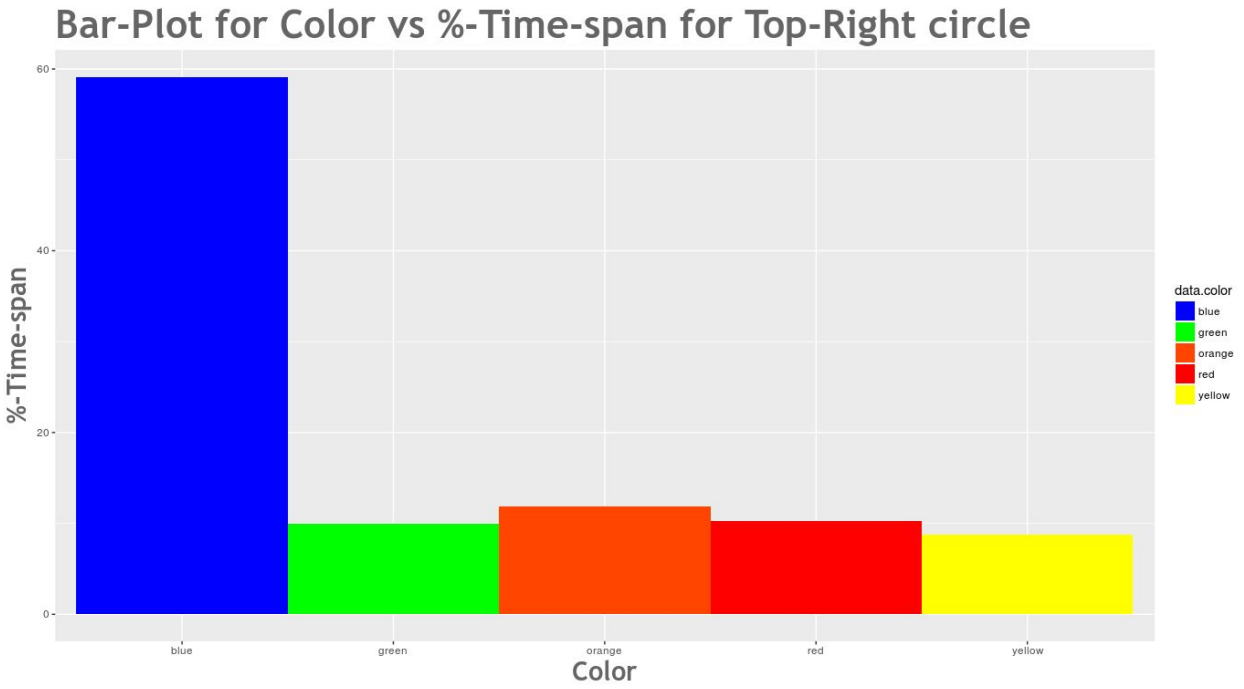
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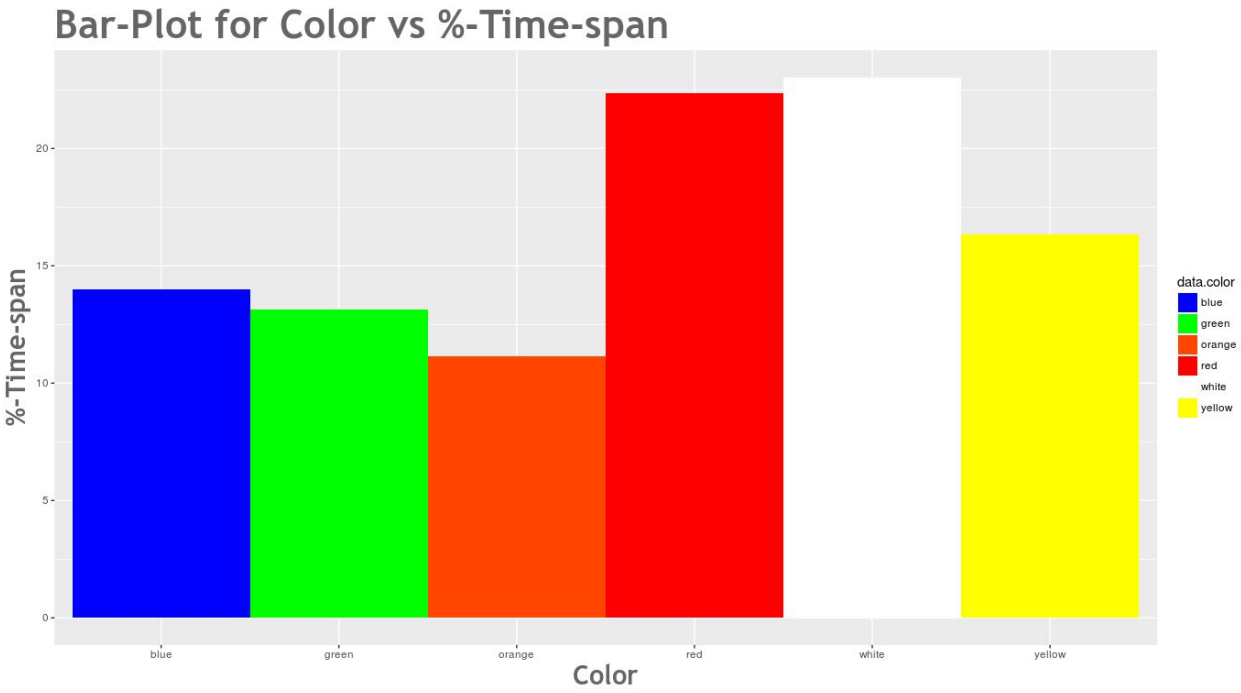
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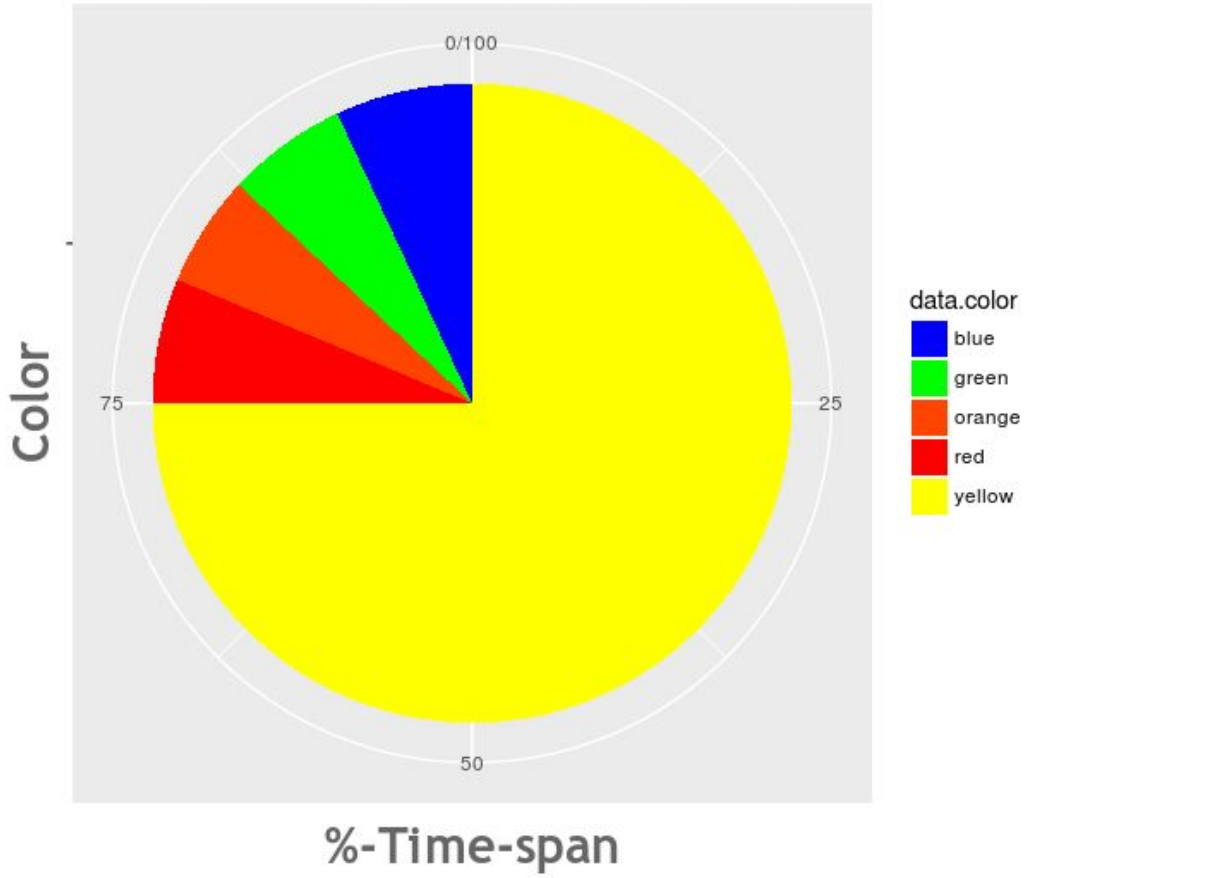
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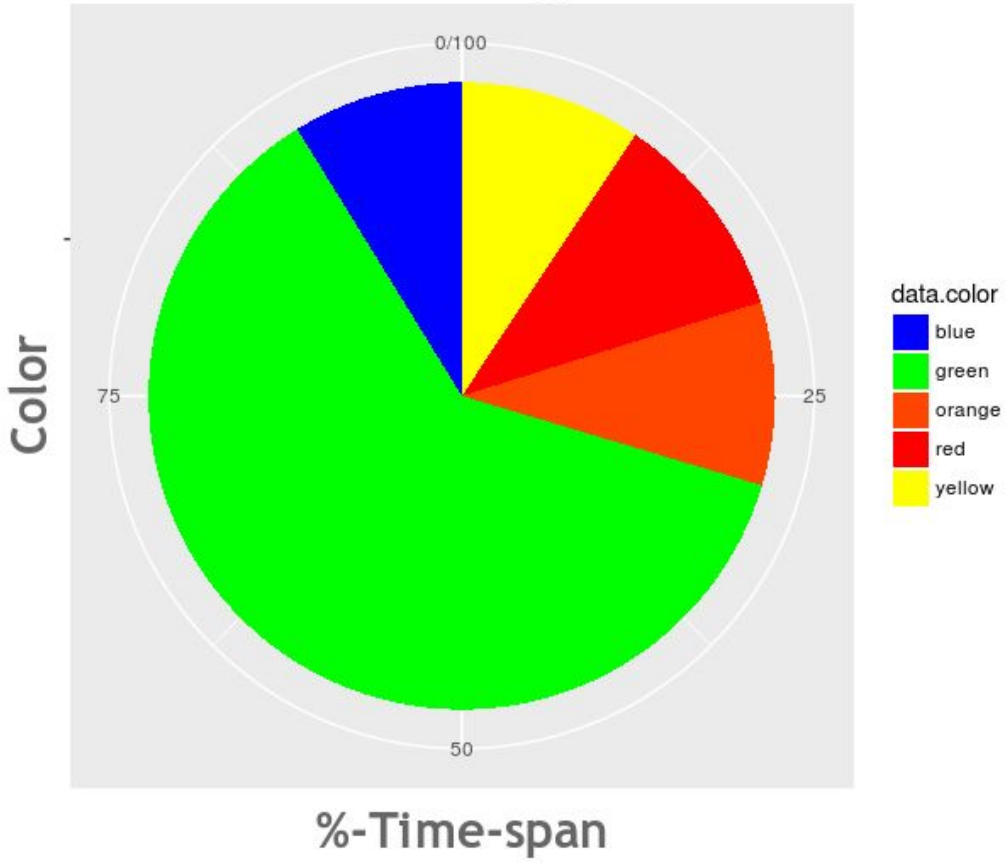
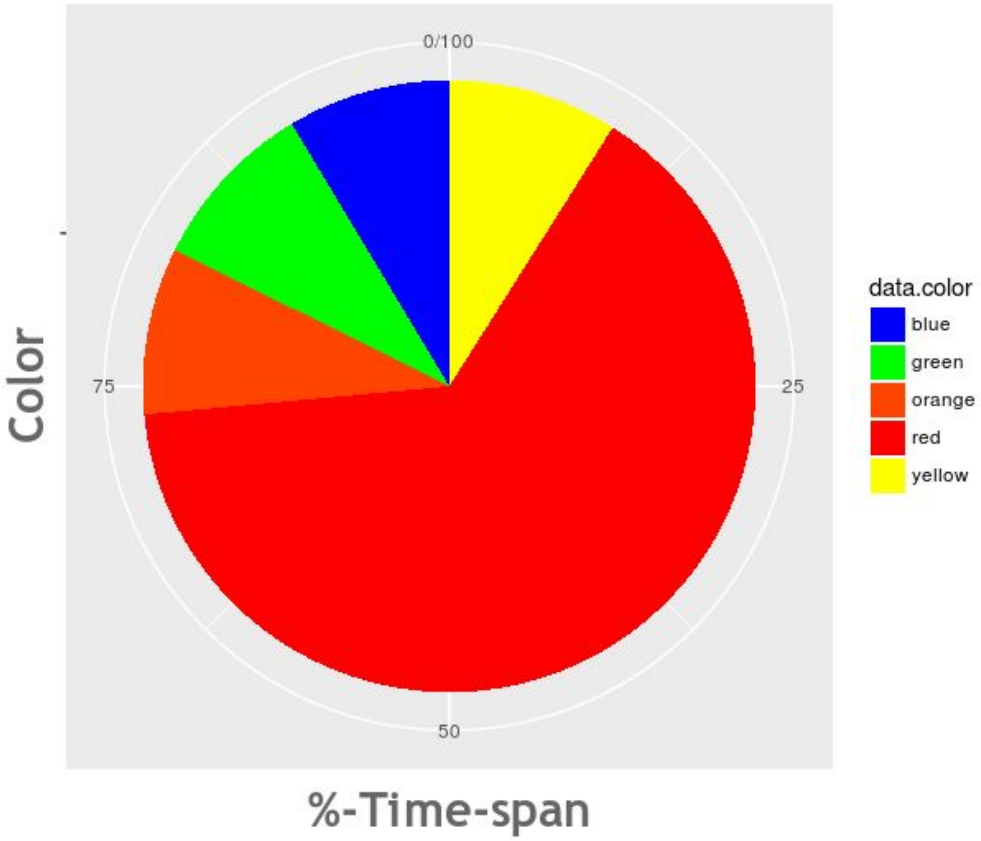
Pie-Plot for Color vs %-Time-span for Bottom-Right circle

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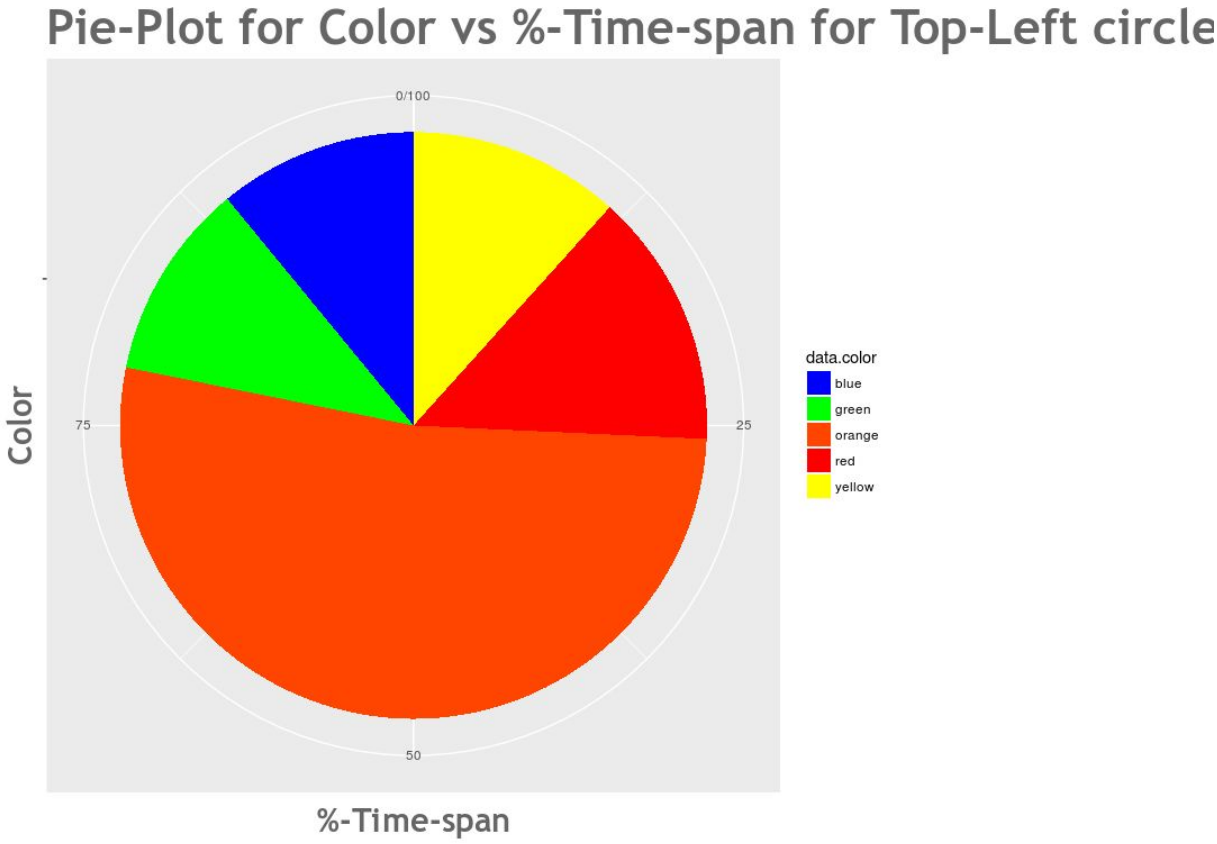
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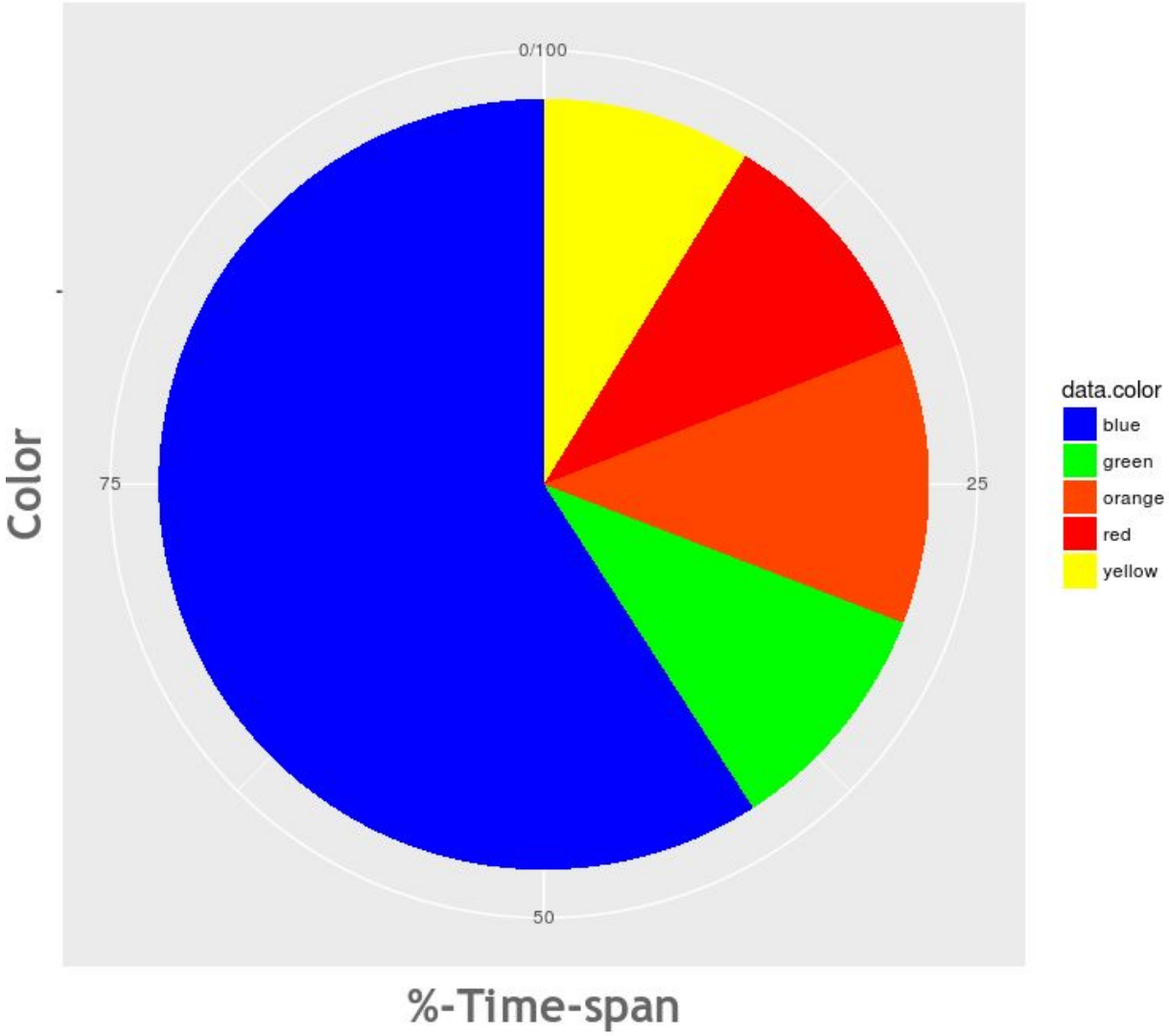

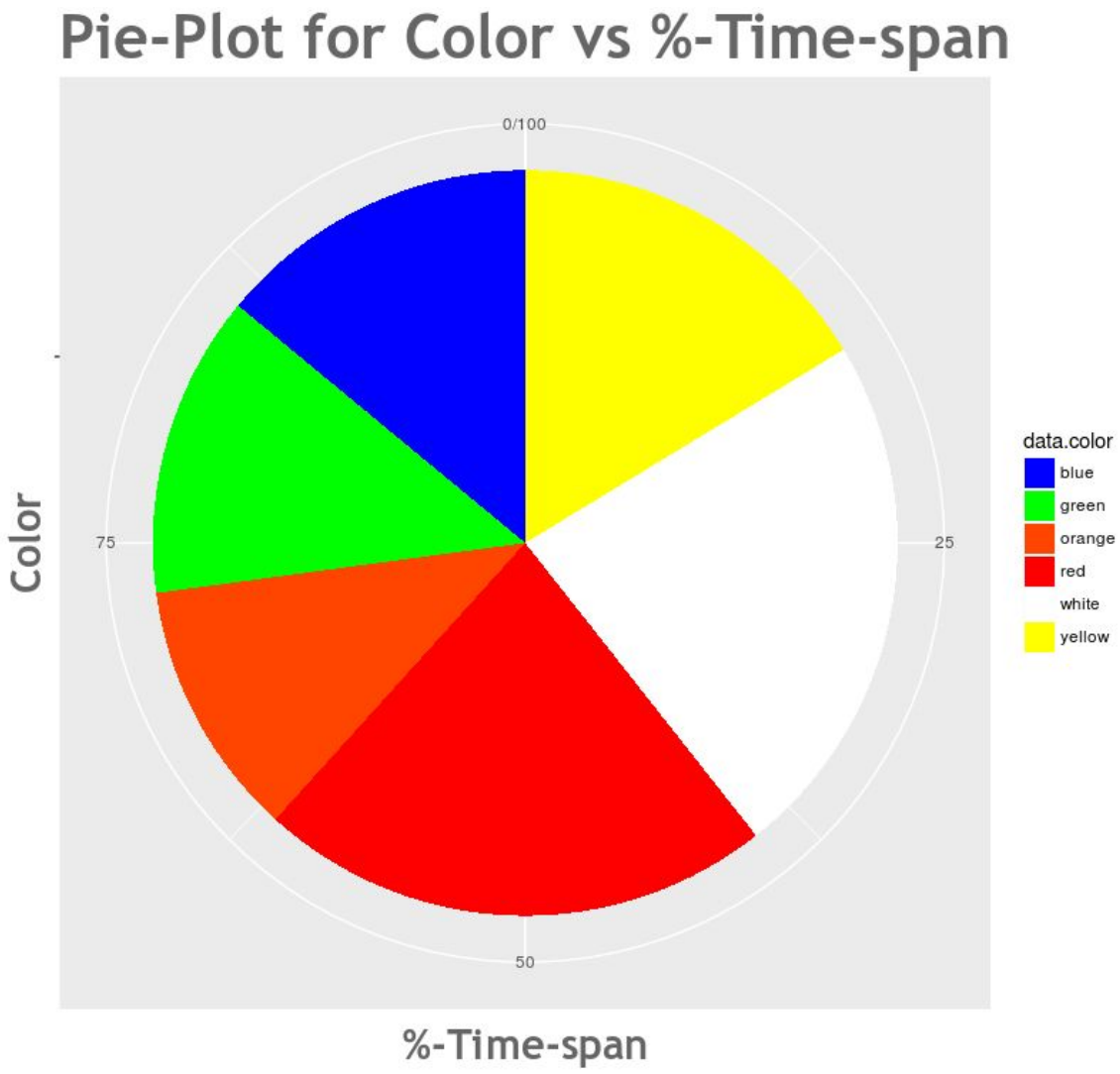
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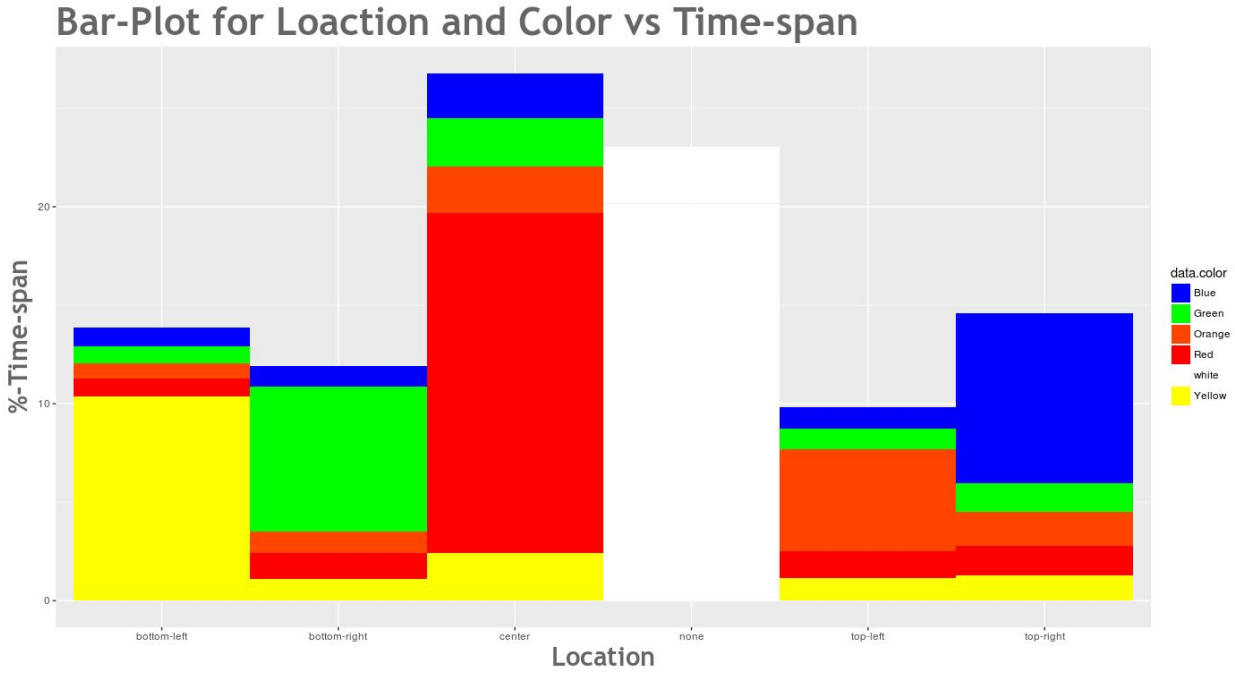
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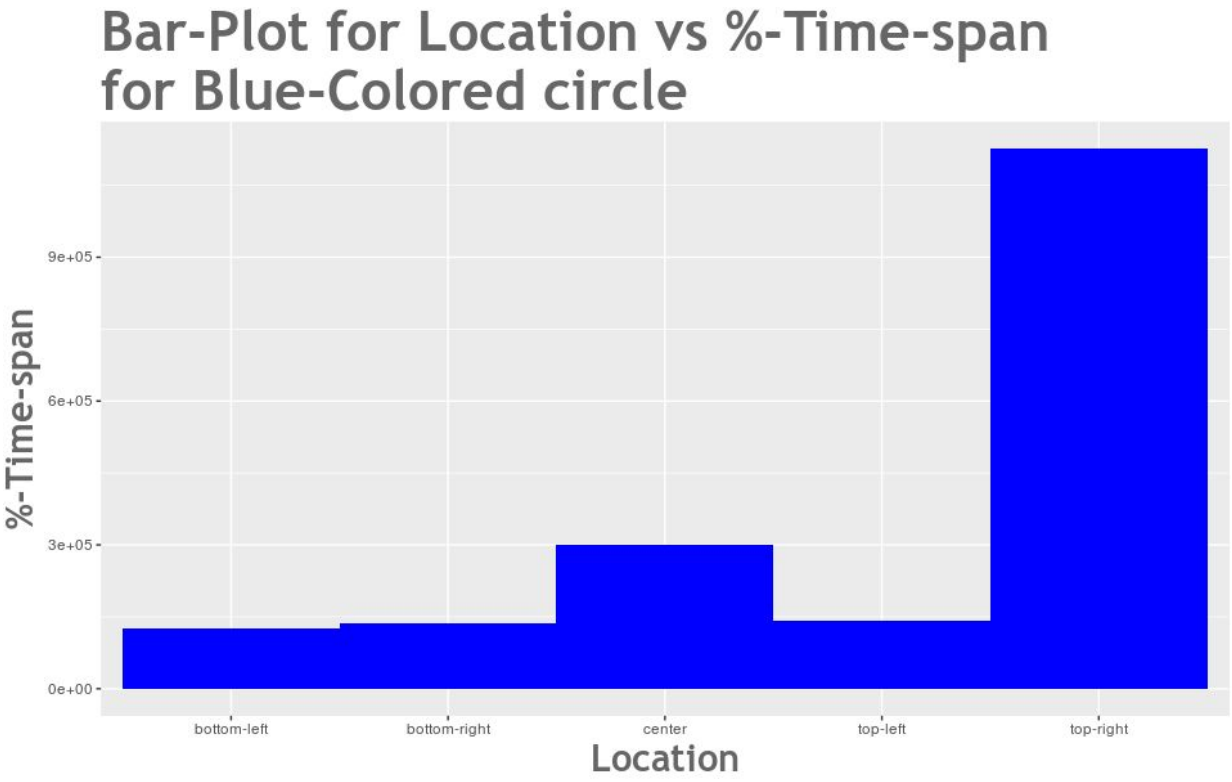
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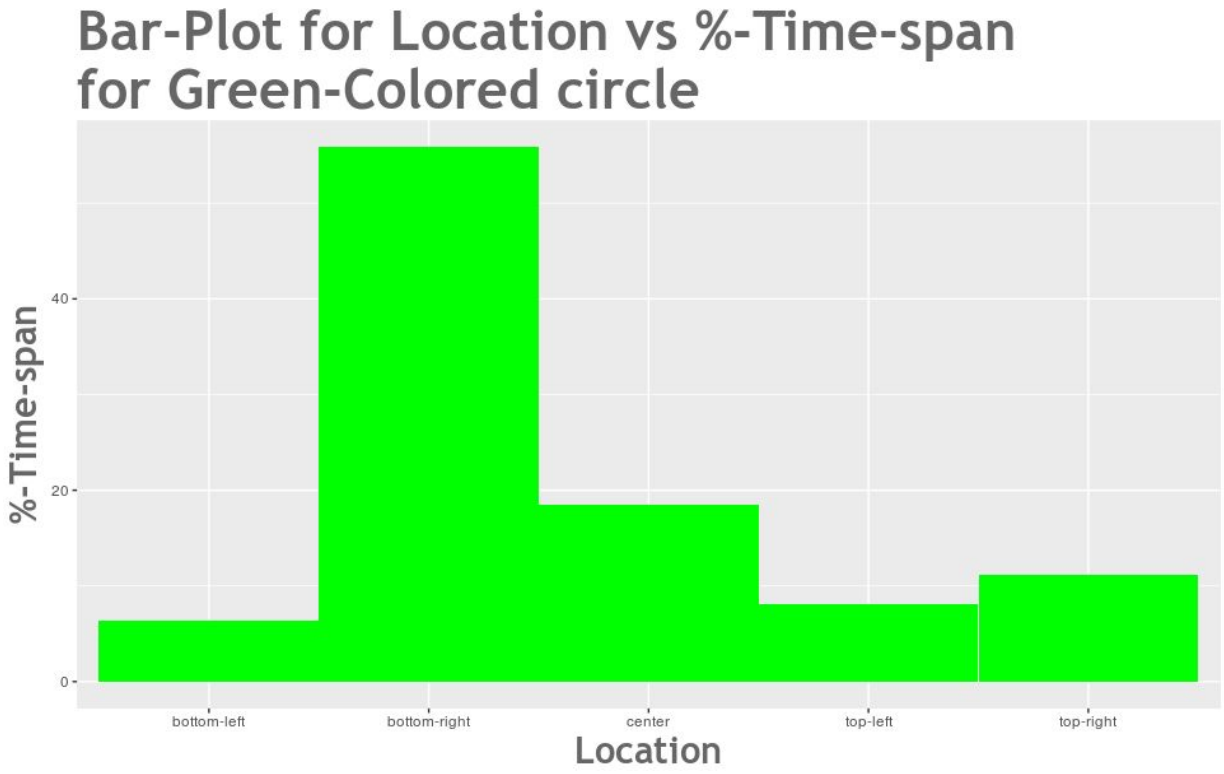
Location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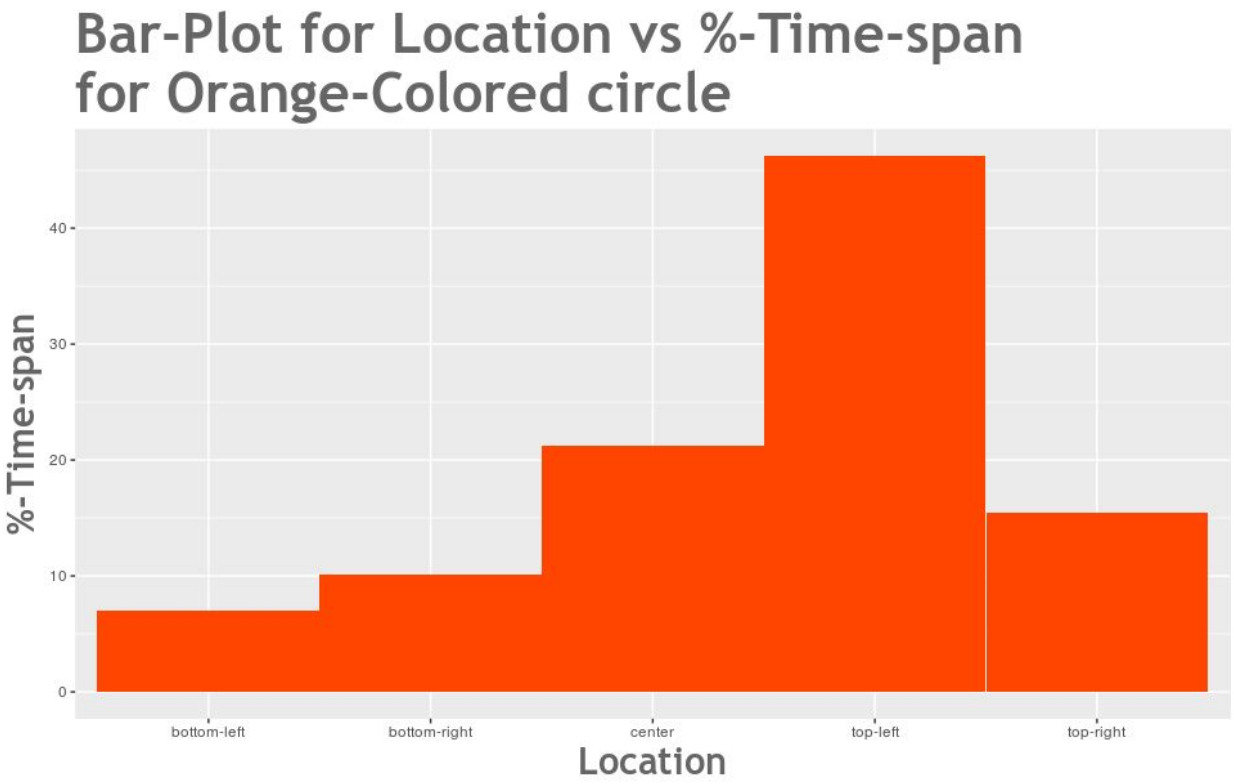
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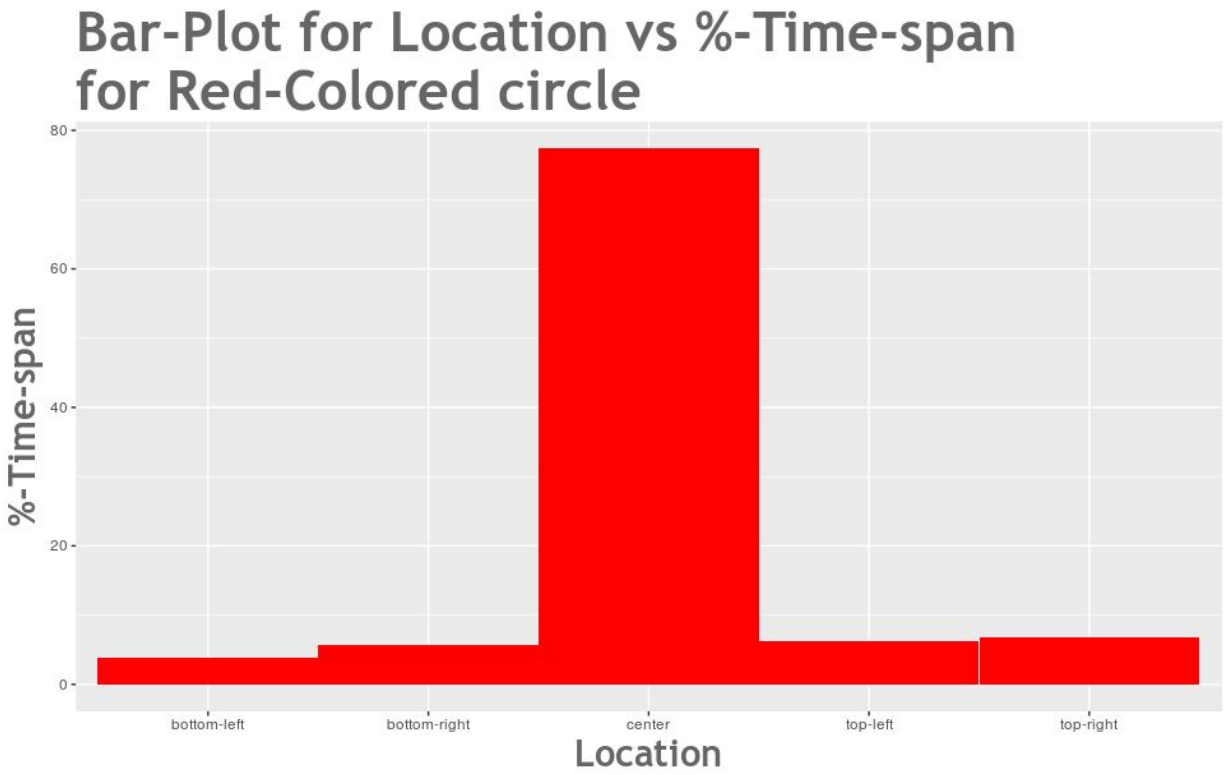
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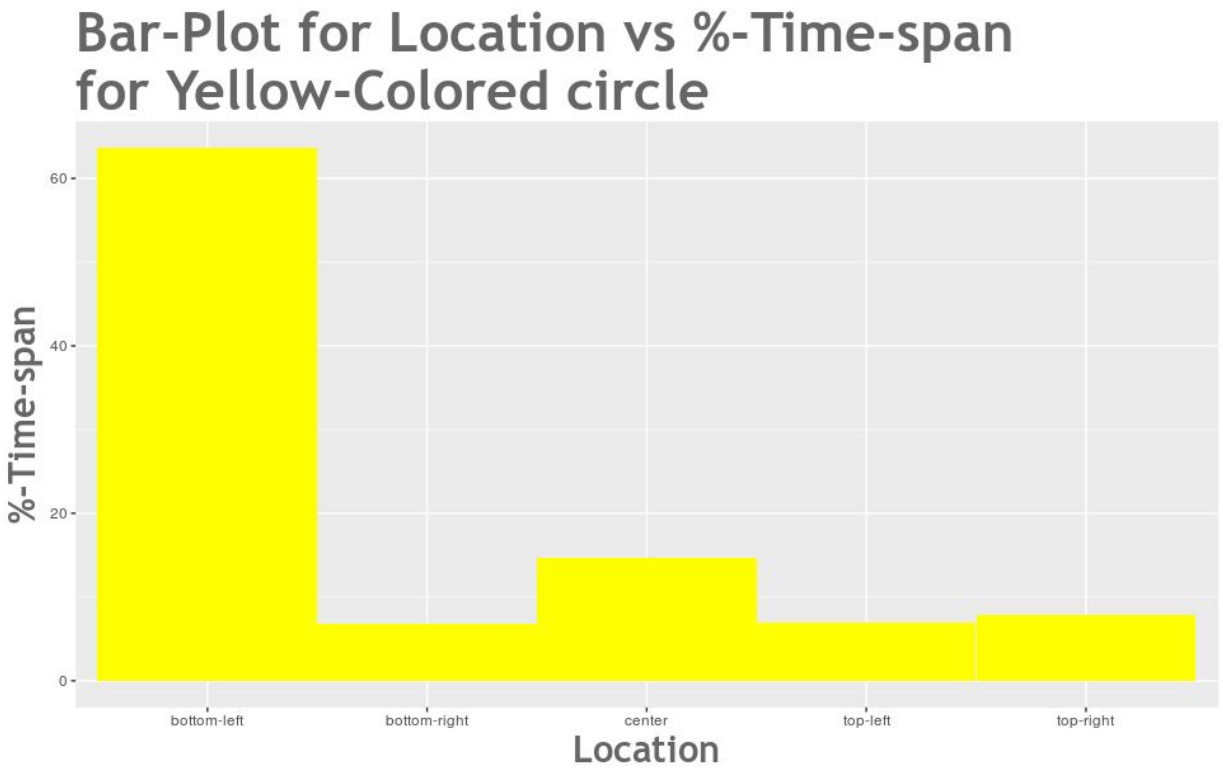
Location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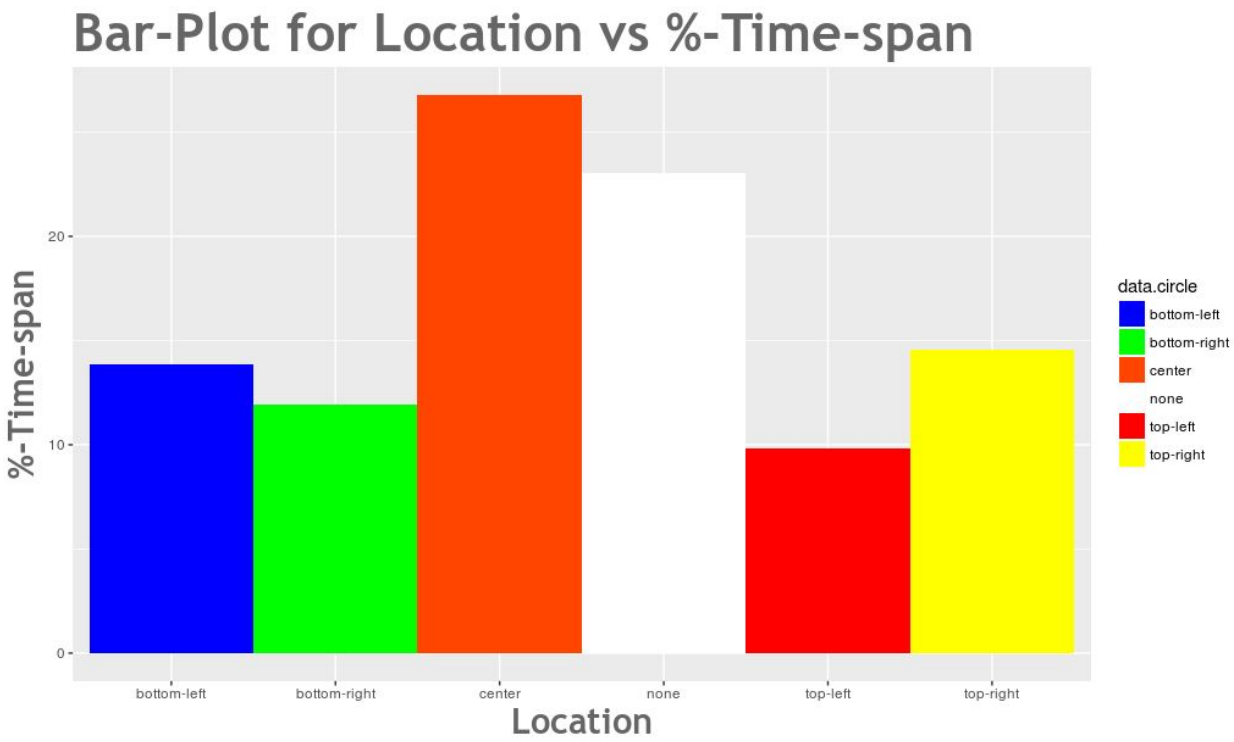
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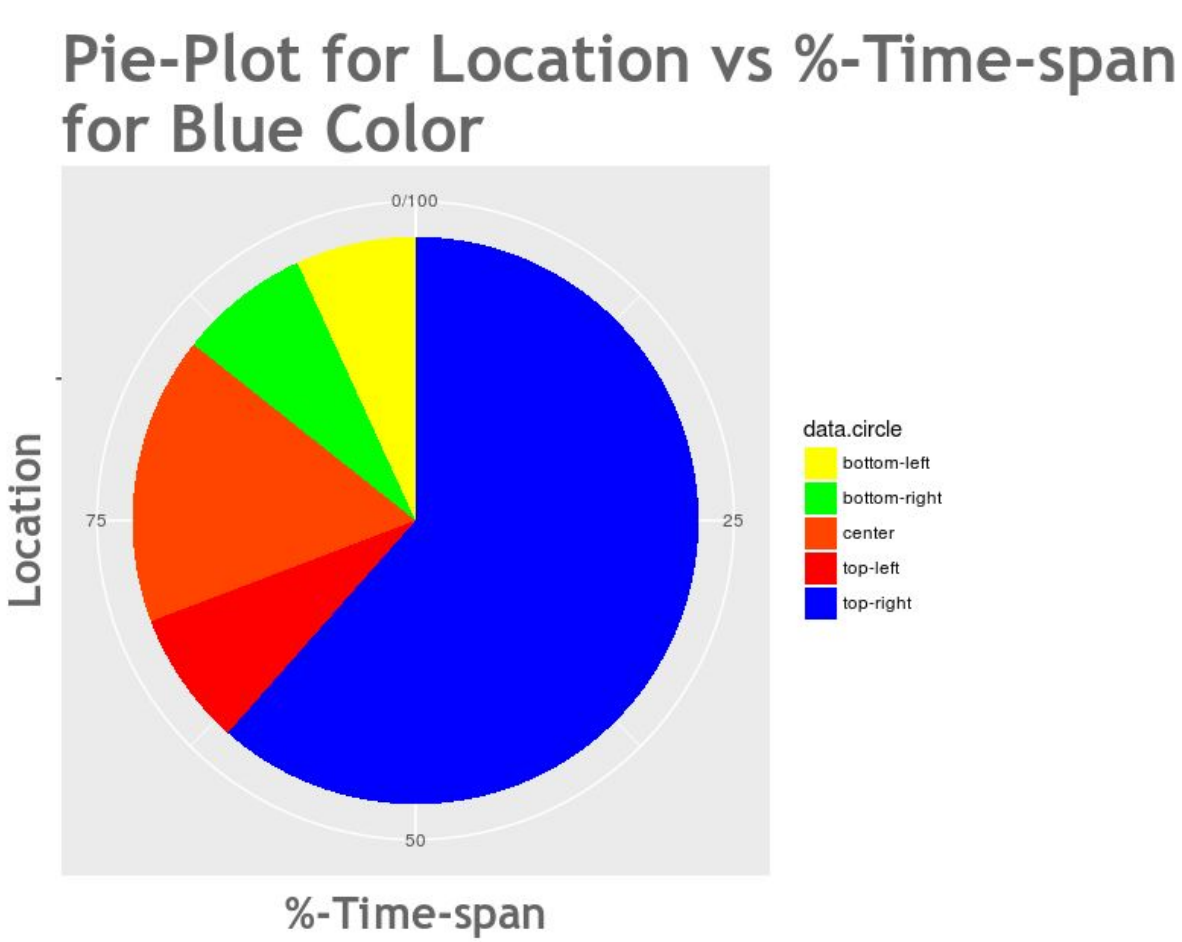
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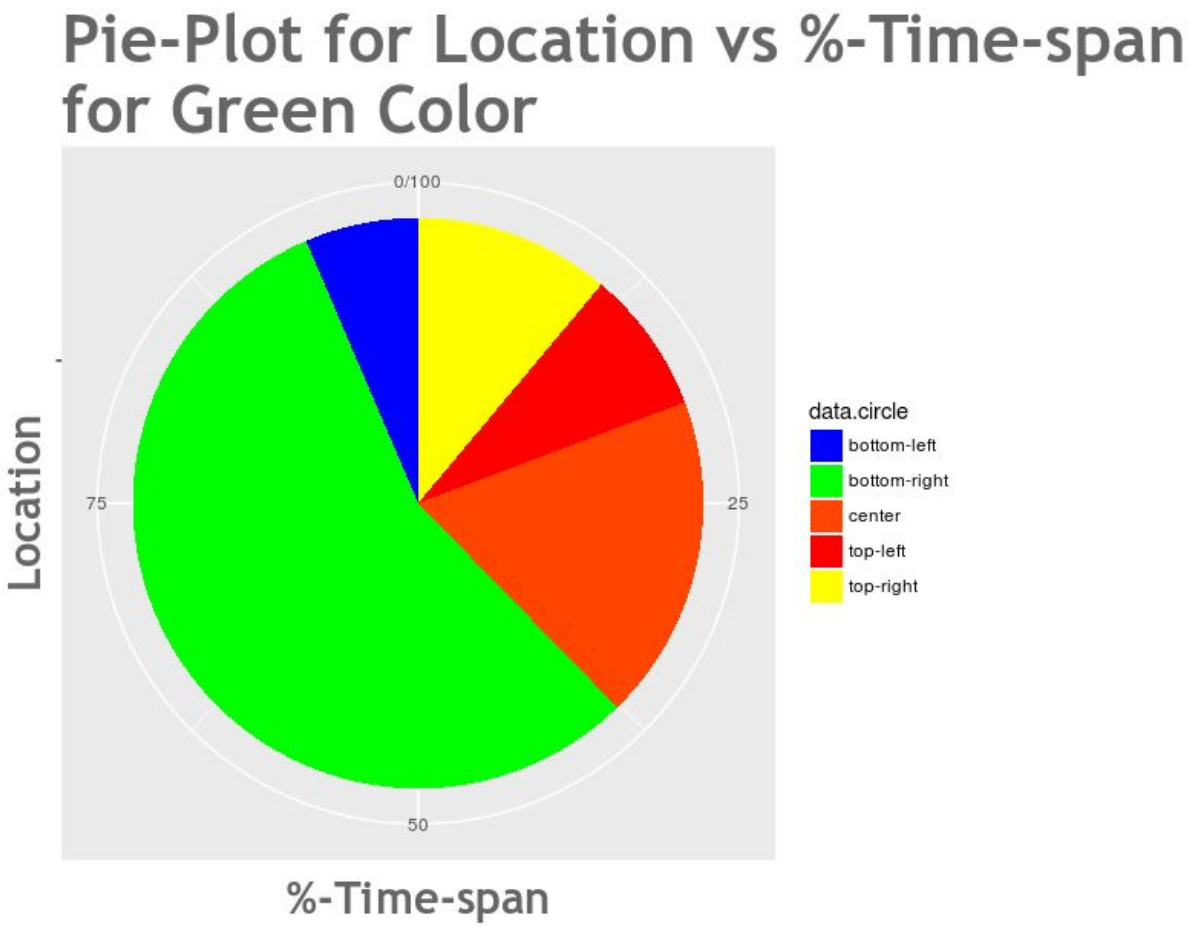
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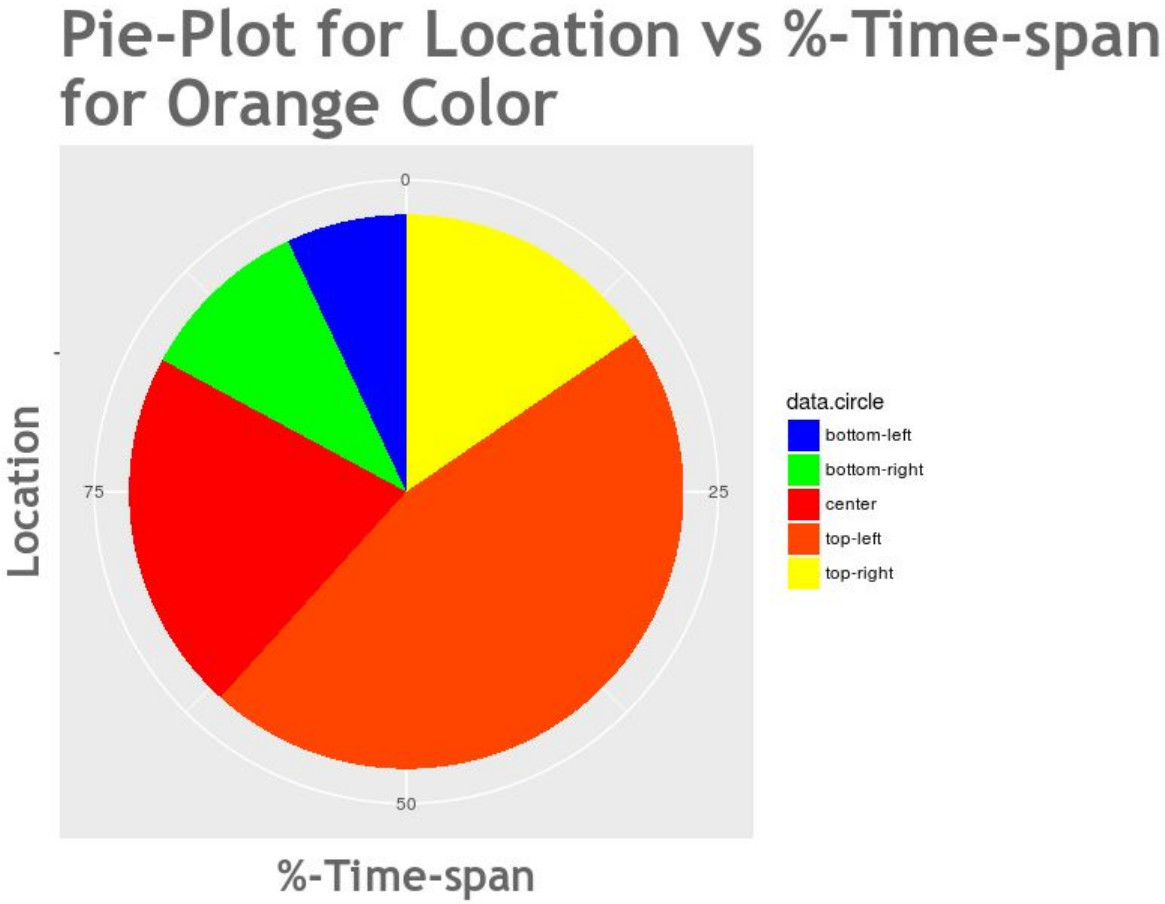
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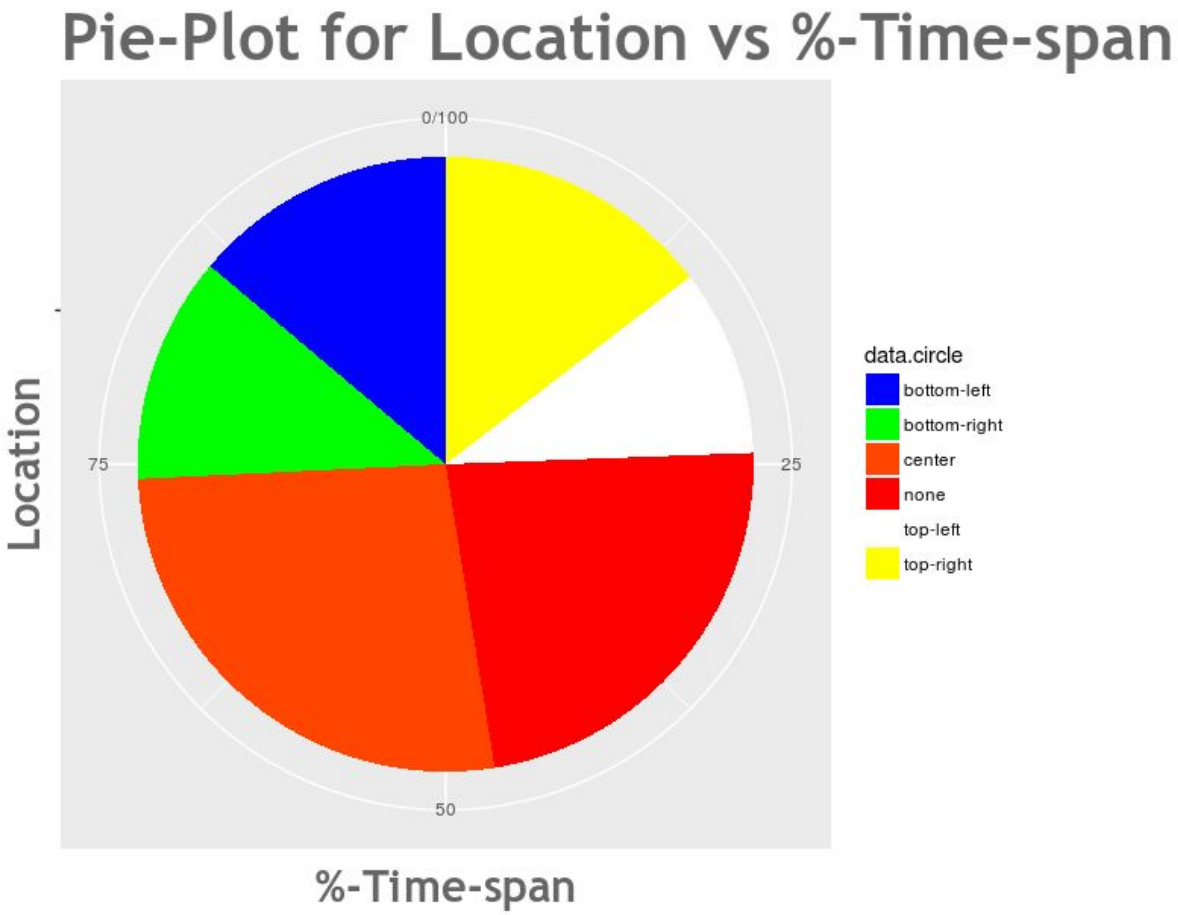
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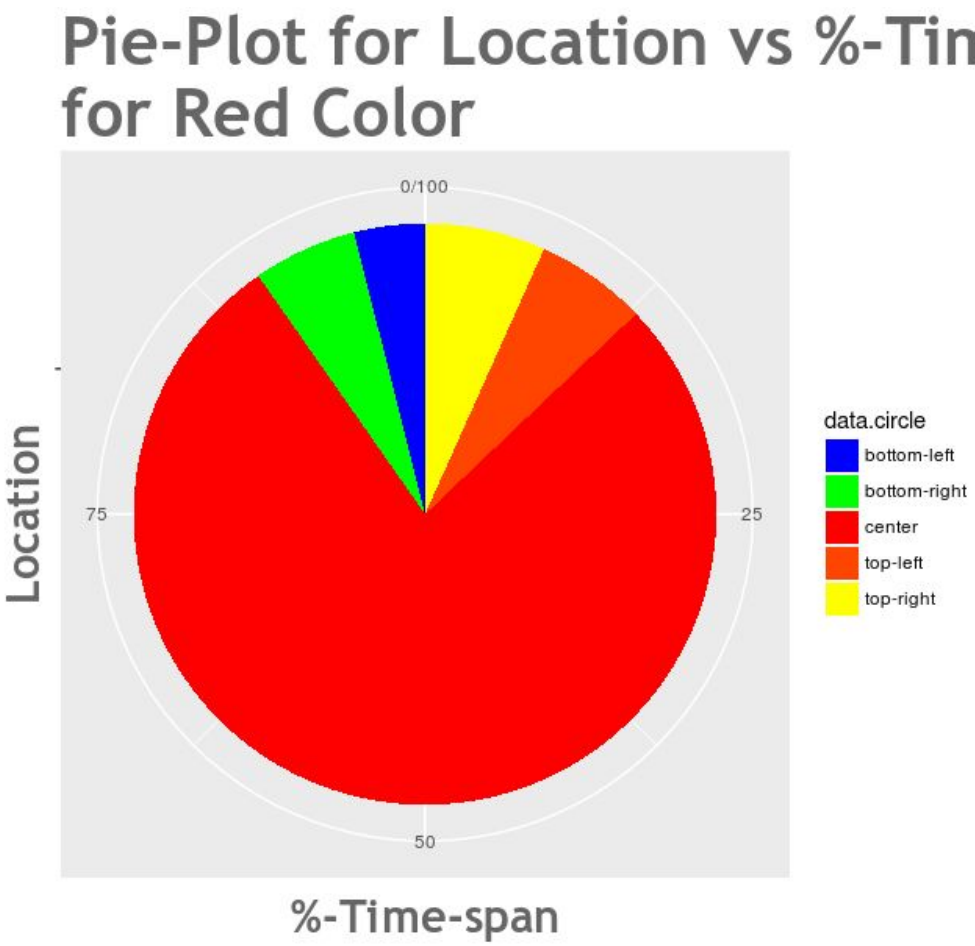
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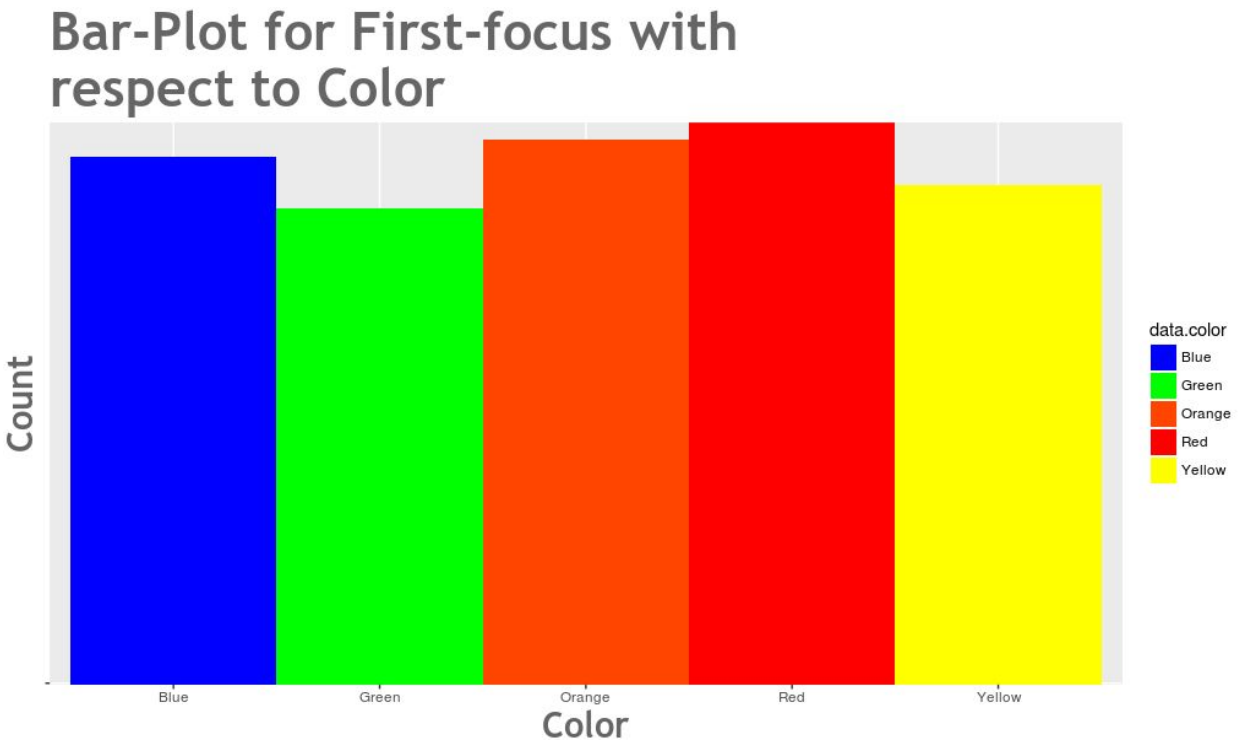
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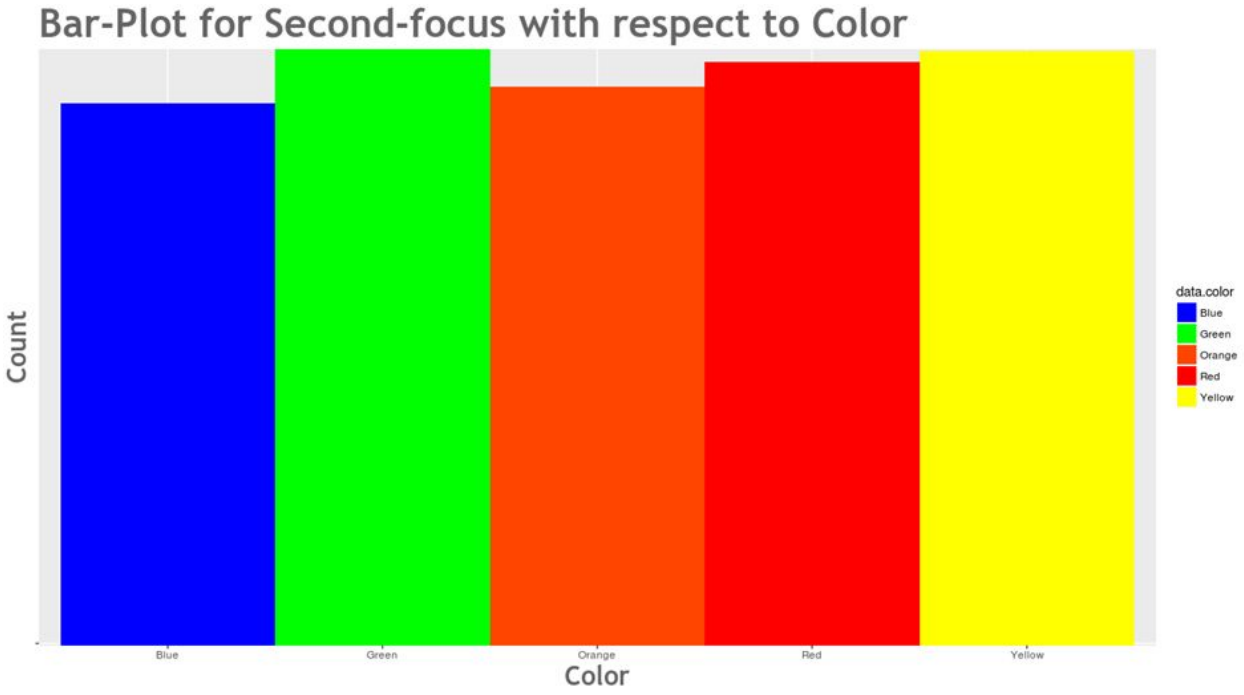
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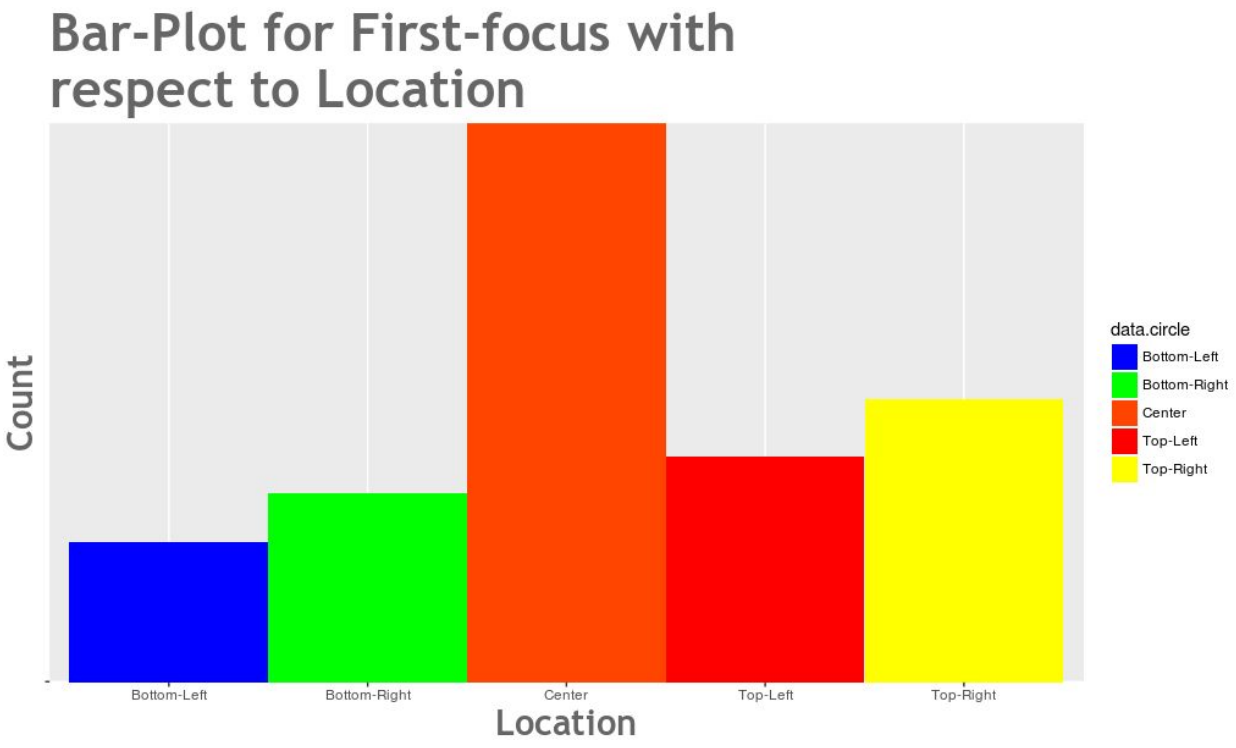
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Bar-Plot for Second-focus with respect to Location
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APPLICATIONS :

This project can have a wide range of applications in the real as well as virtual word. Some of these applications are described below.

Posters :

Results of this project can be used to design creative and visually attractive images. We can display the important message in a particular colour and location, so that it is caught by the viewer easily.

Advertisements :

Advertisements usually need to be catchy. So, with the help of this project, we can predict the position and other visual elements which will catch the eye of public.

Magazines :

An image is worth a thousand words. So, the image should be attractive enough so as to convey the message. This can be implemented using the conclusions drawn from this project.

CONCLUSIONS :

- Blue color is most viewed at top-right position.
- Red color is most viewed at center position.
- Green color is most viewed at bottom-right position.
- Yellow color is most viewed at bottom-left position.
- Orange color is most viewed at top-left position.

- It seems that first focus is more or less independent of colors.
- The first focus in an image is found to be predominantly at the center position.
- It seems that the second focus is more or less independent of colors.
- The second focus in an image is found to be at the center position.

FURTHER POSSIBLE WORK:

This project can be extended further as an aim for having data of eye fixations for a larger set of images. It can also have further applications as described below.

Colors, shapes and locations :

Number of colors used in generation of images for viewing was taken as 5. However, it can be increased from 5 to as many as possible. Similarly, instead of only circles, many shapes can be used and analysis of different shapes can be done accordingly. Also, number of locations in which we divided our whole image can be increased further to analyze data so as to get results with more accuracy.

Data Collection

For this project, the data was collected from only x number of people. However, for further work, number of people from whom data will be collected can be increased depending on the need and available time for sample collection. Larger the size of data collected, greater will be the accuracy of project analysis and better will be the results derived.

Machine Learning:

The world today has a varied application of Machine Learning techniques to efficiently derive statistical data from a large set of input data. The extension of our project can also use the same. Efficient Machine Learning algorithms can be used to not only generate statistical data for a large set of input parameters and input data but also predict eye fixations on varied type of new images such as paintings, magazine articles, newspaper advertisements and many more.