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Graphical Perception Retention Rates

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ABSTRACT

In this experiment we chose to look at how people see graphs and data and to look at retention rates of data based on the style of visualization they are looking at. The problem that we will aim to offer solutions for is lack of retention from visualizations. In other words, how can we display informational visualizations in a simpler and more accurate way so that within a few seconds a user knows what is happening in that visualization and will have a higher chance of retaining that information.

INTRODUCTION

The motivation behind this experiment is poor retention rates of visuals that are typically viewed very quickly. A common issue with visuals that are viewed relatively quickly, is that the viewer will tend to forget most, if not all of the data that was presented to them [the viewer]. The importance and relevance behind this issue is that it can be used by anyone who is trying to convey an important message and do so with minimal data on the visualization. This could be helpful in determining what data should be shown, and the manner in which is it displayed for maximum retention. Below, we discuss the related work we used for reference, the structure of our project and the results we found from the responses.

RELATED WORK

Graphical data display has been a very important role in communicating data in science, business, engineering, and different aspects of mass media. The computer graphics revolution has given people a simple yet costly solution for making graphs, which has caused the production of visualizing data to grow exponentially. With this increase, more and more studies have come out about looking at the science of visualizations involving human understanding. However, there has been very little study on how quantitative information on a graph is visually decoded by the human mind [6]. Studies in graphical perception not only aim to learn how to enhance the decoding process to make it more accurate and efficient but also have a purpose of understanding which visual channels perform best for a given visual task [4].

Looking at different visualizations, there are some better suited for different information than others. For example, bar charts are typically better for comparing quantities of different categories and line charts are better for trends over a period of time [1]. In one of our resources, *5 Visualization Best Practices*, Emily Rugabar talks about some factors that can positively affect a visualization. The main takeaway from this was to use the right visualization for the right purpose. This can relate to the research study by looking at the Rolling Stones dataset and seeing which visualization type is the most effective for this type of data.

One of the studies that prompted this research project was *Graphical Perception: Theory, Experimentation, and Application to the Development of Graphical Methods* [2]. The study ranked which attributes of visualizations people were able to decode most accurately, the list went as follows:

1. Position along a common scale
2. Position on identical but nonaligned scales
3. Length
4. Angle and slope
5. Area
6. Volume Density, and color saturation
7. Color hue

These are common attributes in almost all visualizations included the ones made for the research study. A different study at The University of Washington also identified these same attributes in their ranking of effectiveness [3]. What was interesting about this study is the university created two design principles: effectiveness and expressiveness. An expressive visualization expresses all the facts in the set of data and only the facts in the data, meaning having no opinion tied to the visualization and only truthfulness as opposed to dishonesty. An effective visualization is one that is more readily perceived in comparison with other visualizations [3]. These attributes and design principles can be analyzed and applied to the visualizations being used in the research study to make sure they are factually correct and can be interpreted by the average person.

The focus on effectiveness is important when talking about visualizations and defining goals of user tasks. This leads to conversation around accuracy, correctness, and truth playing a central role in your visualization [8]. Another important focus on visualizations is the beauty of them and making them look like art. For emotional engagement for the viewer, it is sometimes looked at as appropriate to tell a story with the data and add attributes that could evoke feelings about the visualizations. In contrast, visualization designers don't have an artistic license and the phrase, "it's not just about making pretty pictures" is common when on this topic of artistic visualizations. This can mean that the ultimate goal of the creator is not met if the vis is pretty but not effective [8].

This debate continues in other aspects of visualizations. Colin Ware in his book *Information Visualization* brings up the question, "is visualization a science or a language?" [5]. This question can be seen from both ways. It can be seen as a science because it must represent data accurately so one can see the underlying trends and patterns. It can also be argued to be a language because it uses diagrams to convey meaning. Data is encoded into symbology and semiology [5]. It is interesting to analyze how people interpret things differently, especially in this line of work.

Human perception of visualizations is something that has been studied for years and is still continuing to be studied to this day. One of the reasons data visualization is effective is because it shifts the balance between perception and cognition to take fuller advantage of the brains abilities [9]. Seeing, considered to be visual perception, is handled by the visual cortex which is extremely fast and efficient and located in the back of the brain. This allows us to see immediately with little effort. Thinking, cognition, functions primarily through the cerebral cortex in front of the brain, which is slower and less sufficient [9]. Traditional methods of presenting data and attempting to absorb that information requires conscious thinking to do almost all of the work. When we use data visualizations, this shifts the balance to making our brains use visual perception, taking advantage of a scientifically faster processing system [9]. This pertains to the study by analyzing what people are retaining from the information they are giving. These are artistic visuals based on a big data set. Subjects retention rates are based on what they are seeing and absorbing in the amount of time given.

DESCRIPTION OF PROJECT

Our project was set up to determine how different visualizations affected retention rates. We accomplished this by creating three visualizations of the same exact data, displayed in three different ways. [Shown below] All the data was the exact same, looking at number of records by genres from The Rolling Stones Greatest Albums of All Time. We chose to make the visualization fairly simple, and color coded to see how color affected their retention we well as shape and size. Next we created a survey with questions regarding the visualizations. Following that, participants were asked to study one of the visualizations for no more than three minutes before being distributed a survey that asked questions regarding the visualization they looked at.

Chart 1

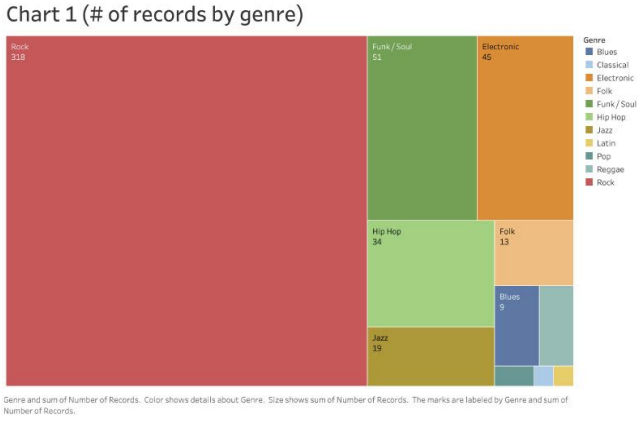


Chart 2

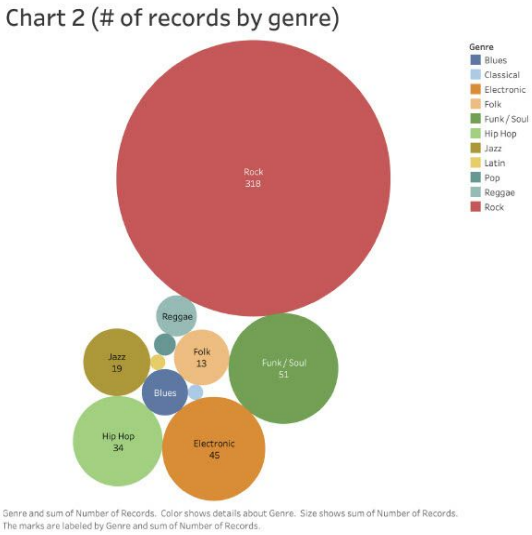
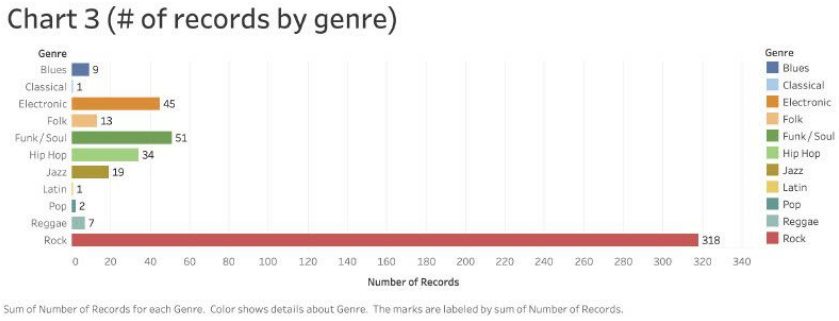


Chart 3

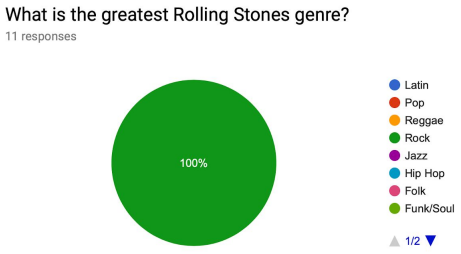


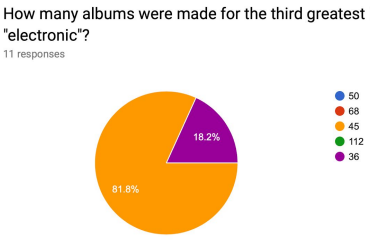
WHAT WE FOUND

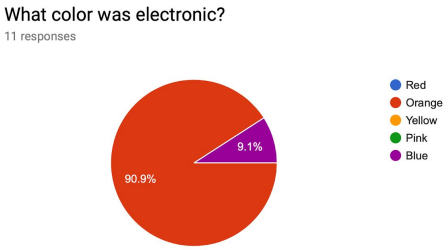
Based on the responses we received from the survey, and the responses participants left, it can be concluded that the circular visualization was least effective for this specific data set. Some of the responses stated that because “it did not read from left to right” and the order was random, that it was hard to retain what we being shown. Additionally, some of the participants stated that the small circles were hard to see data and distinguish from others, if any data at all was displayed.

The hierarchical tree map in this case is potentially the best way to visualize this data for determining the biggest to middle genres. Because it reads in a left to right “zig-zag” pattern, participants found it easy to follow along and retain the data. Grounded on these results, in would be in a persons, companies, or organizations best interest to use a hierarchical tree map in order to deliver the best retention rate possible to their audience.

SURVEY RESPONSES







“It was easy to remember the bigger genres, such as rock, electronic, Funk/Soul, but it was harder to get a grasp of the smaller data points (like classical or pop) that didn't have a label on the graph or a number of records. Also, there were so many similar colors that it became confusing trying to remember which color corresponded to which genre”

“The bubbles were in a different reading fashion compared to something you may read left to right.”
“I like the subject and have background knowledge so it made it easier to memorize faster.
In the middle due to the graph being visually complicated at first glance and difficult to follow along with.”

“No smaller data stuck.”

“The bigger boxes were clear to read, and it was easy to distinguish the larger ones.”

“Because the size of each box correlated to the number of albums and the genre name was matched with a similar color to its name, for example; red was rock. The graph also reads from left to right in a Z like patterned that moved the viewers eyes through the graphic using hierarchy.”

“The bars made it easy to see the biggest category, although the middle sizes merge together a little bit. Still it was generally easy to comprehend.”

“The size of the squares made it easy to visualize what information was most prevalent and
the color code made it easy to read the legend as well.”

“It was clear and easy to read and the data was displayed nicely and color coded!”

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