

Investigating User Preferences towards Visualization Types with a Focus on Neuroticism and its Implications on Mental Health

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Abstracts: This study delves into the importance of visualizing mental health data to attain a comprehensive understanding of psychological disorders through the means of data storytelling and information visualization. Utilizing the Five Factor Model, the article investigates the correlation between two prevalent mental health conditions, depression and anxiety, with a specific focus on the neuroticism trait. The researchers aim to underscore the potential of data-driven techniques in shaping mental health interventions and promoting a deeper comprehension of these conditions by exploring the association between neuroticism and various visualization approaches. To achieve this objective, the study employs quantitative research methods to support population association analysis, cause-and-effect analysis, and the assessment of the link between independent and dependent variables. The findings show that neuroticism has no relationship to any sort of visualization types, and this paper presented several explanations for the lack of a relationship between visualization type and neuroticism.

Keywords: Depression, Anxiety, Mental Health Issue, Five Factor Model, Neuroticism, Visualization Types, Data Storytelling, Data Visualization.

1. INTRODUCTION

Today's society is seeing an increase in mental health problems like depression. Depression is a severe mental illness that affects a lot of people, and the neurobiological changes that depression causes are still not fully understood [1]. When depression can result in more serious instances like criminal behaviour, social issues, and suicide, the scenario can be quite concerning. Age, gender, and having friends who were infected with the illness were significant predictors of depression and anxiety during the third wave of COVID-19 in Malaysia, where a significant portion of the population (25.1%) had severe depressive symptoms and one-third (34.1%) had mild to moderate anxiety symptoms [2].

Relaying an effective, meaningful and easy-to understand communication of complicated and huge chunk information depends heavily on data visualization [3]. Understanding how various people interpret and interact with visual representations becomes increasingly important as technology develops and the world becomes more data driven. Examining the link between user preferences for visualization styles and psychological characteristics might reveal insightful information on the nature of the human psyche and how it may affect mental health [4].

The emphasis of this research is on in-depth examination into user preferences for various visualization patterns using the five-factor model (FFM) especially the neuroticism trait, a personality trait linked to a propensity for feeling unfavorable emotions including worry, tension, and despair [5]. It has been demonstrated that neuroticism has a considerable impact on a person's cognitive and emotional reactions to a variety of stimuli, including data visualizations [6].

Despite several reminder about how it is a crucial component of human total, mental health is still a complicated and varied topic. Researchers, designers, and practitioners can create more individualized and sympathetic data visualizations that are better adapted to the emotional requirements of various people by having a greater understanding of how visualization preferences relate to neuroticism. The researchers examine previous work on neuroticism and its potential impacts on how people perceive and understand data visualizations. By performing empirical studies with a range of user groups with the goal of finding trends and connections between neuroticism and user preferences for

visualization type.

This study has a wide range of implications. First, it has the potential to improve data-driven insight design and communication, enabling more effective information transmission, particularly to individuals who could be more vulnerable to emotional reactions brought on by visualization features. Second, by understanding how neuroticism may affect user preferences, mental health professionals can learn how to adapt information presentation to accommodate people with different emotional inclinations.

In conclusion, this study strives to bridge the gap between data visualization research and mental health, bringing to light the importance of understanding the connections between neuroticism and user preferences, and ultimately can make data more engaging, useful, and understandable to wider audience. By combining empirical findings and theoretical frameworks, the researchers aspire to offer practical recommendations for creating inclusive, emotionally resonant visualizations that cater to a wide array of users while promoting mental well-being. Ultimately, this research aims to foster a more empathetic and insightful approach to data visualization in an increasingly data-centric world.

2. RELATED WORK

In this study, an extensive literature review was conducted, drawing from reputable sources to explore the connection between neuroticism, depression, and the use of personality trait indicators to predict individuals' attitudes. Subsequently, the following section delved into previous research that examined the intersection of neuroticism and depression with a particular emphasis on the application of psychological theories for data visualization and data storytelling

2.1 Five-factor Model

Five traits make up the Five Factor Model, a popular personality framework: neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness [7]. Neuroticism plays a critical role in determining a person's propensity for anxiety and depression. It is not surprising that neuroticism is prominent in the most popular models of personality, personality disorder, and psychopathology given its major role in so many various types of mental and bodily dysfunction [8]. The levels of neuroticism in a person can be used to gauge their level of mental maturity. Those with higher levels of neuroticism are more likely to feel negative emotions like depression and anxiety [9]. A person with a high neurotic score will likely react emotionally to situations and be unable to handle difficult situations rationally. Low neuroticism describes a calm, less sensitive someone who is totally devoid of unpleasant feelings FFM was chosen as the study's personality indicator because it is prominent in both academic and therapeutic psychology.

2.2 Data Visualization / Information Visualization

Data visualization is a method to communicate, abstract data and to aid in data understanding by leveraging human visual system [10]. The purpose of today's visualization is to deliver user-friendly, interactive, and visually beautiful visuals that can successfully communicate complicated data to a wide range of audiences [11]. Effective analysis and communication of data related to mental health are made possible by data visualization. Researchers can identify patterns and trends by using various visualization techniques that conventional statistical methods might miss. A study suggests a web-based method for quickly visualizing big data from brain MRI scans using an automated image capture and processing system, nonlinear embedding, and interactive data visualization tools. This method is crucial as datasets get bigger because it enables researchers to quickly identify and extract important information from big data sets [12]. The findings demonstrate that the suggested method enables researchers to pinpoint intriguing gray matter and volume patterns and assess how they relate to various variables like scanning, age, and gender.

2.3 Data Storytelling

Data storytelling is the process of using data or information to tell a story. This activity aids in the viewer's understanding of the displayed information [13]. The assumption among those who work in the visualization field is that

creating a story with visual data promotes memorability and engagement, which improves the effectiveness of informational delivery [14]. Data storytelling is a narrative-driven method of data interpretation, allowing researchers to present difficult findings in an engaging and understandable way. In this study, the researchers examine how an individual's level of neuroticism might influence their preference for specific data visualization types. Understanding this relationship could facilitate the design of tailored visualizations that resonate with individuals experiencing mental health issues.

3. METHODOLOGY

To support population association analysis, cause-and-effect analysis, and assessment of the link between independent and dependent variables, this study uses quantitative research methods. To acquire data on opinions, knowledge, intentions, user experiences, usability testing, and the frequency of use within a particular area throughout time, survey research was employed [15].

A total of 112 undergraduate students from one local university make up the study's population. To account for variances in level of education, reduce administrative costs, and address potential response biases, the researchers narrowed their target sample to undergraduate students. The Five-Factor Model International Personality Item Pool (FFM IPIP-NEO) form, which measures extraversion, agreeableness, openness, conscientiousness, and neuroticism, was used by the researchers to evaluate the personality qualities of the individuals. The instrument was used to gauge the participants' proficiency in each of the five FFM personality domains by measuring their personality scores. Subdomains were further divided into for each domain. A condensed version of the original IPIP-NEO with 120 components was employed in this inquiry. This shortened version was created to evaluate the same traits as the full version, but more effectively and with fewer components. It's crucial to keep in mind, though, that the instrument's website rates the longer, original technique as being more dependable. Time restraints and a desire to avoid participant apathy and inattention played a role in the decision to adopt the condensed version.

The questionnaire used in this study was modified from a survey used in a prior study by Gonc, 2020 that looked at user preferences [16]. The poll was separated into three contexts and included illustrations of each visualization. On a 7-point Likert scale, with 1 denoting the least favorite and 7 denoting the most favored design, participants were given similar questions and asked to rank their favorite visual designs. The survey was redesigned to include a new section called "Storytelling Elements Preferences" as well as the following attributes: User Context, Font, Buttons and Icons, Information Density, Navigation Bar Position, Hierarchy Visualization, change over Time Visualization, Comparison Visualization, and an additional section called "Storytelling Elements Preferences."

Participants assigned scores based on how they felt from the five main characteristics—Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness to Experience—related to their preferences. Extraversion was specifically linked to a person's gregarious and outgoing personality. Likeability, cooperation, and compassion were all correlated with agreeableness. A person's feeling of accountability, work ethic, and self-discipline are all examples of their conscientiousness. The ability to be open involved using one's imagination, being creative, and being eager to try new things. Finally, emotional stability and the propensity to feel unpleasant emotions were linked to neuroticism.

4. RESULTS

The distribution of personalities and visual styles throughout the demographics was examined using frequency analysis. This kind of study evaluates the accuracy of these predictions and aids in predicting the chances of specific values happening in a changeable phenomenon [11]. In order to comprehend the class distribution for each set of supplied data, frequency analysis is useful. The researchers can see how frequently different values or categories appear, which gives insights into the distribution patterns within the dataset.

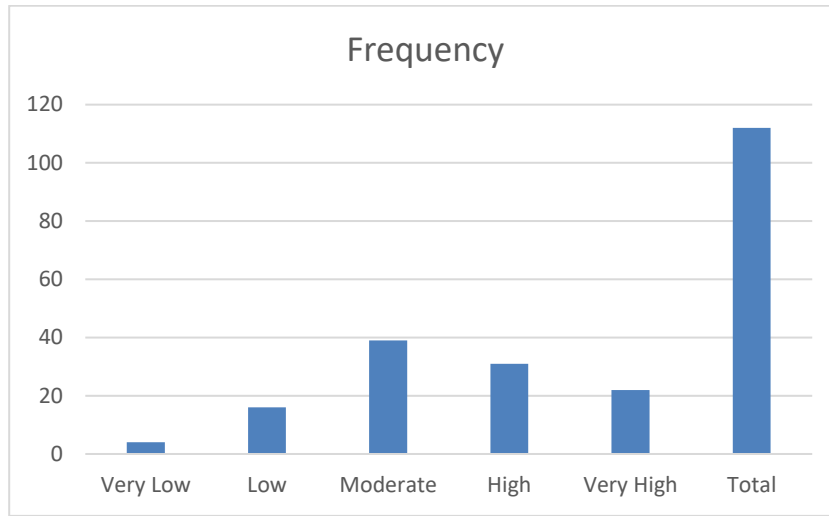


Figure 1. Horizontal bar of neuroticism personality trait

Figure 1 indicates that the moderate neuroticism score, which accounts for 34.8% of the entire sample, is the most prevalent among participants. Many people appear to experience neuroticism moderately, suggesting a generally balanced emotional and mental state. Neuroticism is linked to emotions of sorrow, moodiness, and emotional instability. The least frequent among the participants is a very low neuroticism score, which is represented by only 4 frequencies and makes up 3.6% of the entire sample. The moderate neuroticism scores of the individuals do, in fact, indicate a medium level of emotional capacity. Realists tend to have moods that fluctuate slightly depending on the events and circumstances of the day. As a result, they are more likely to react to situations with a range of emotions and have a practical outlook on life.

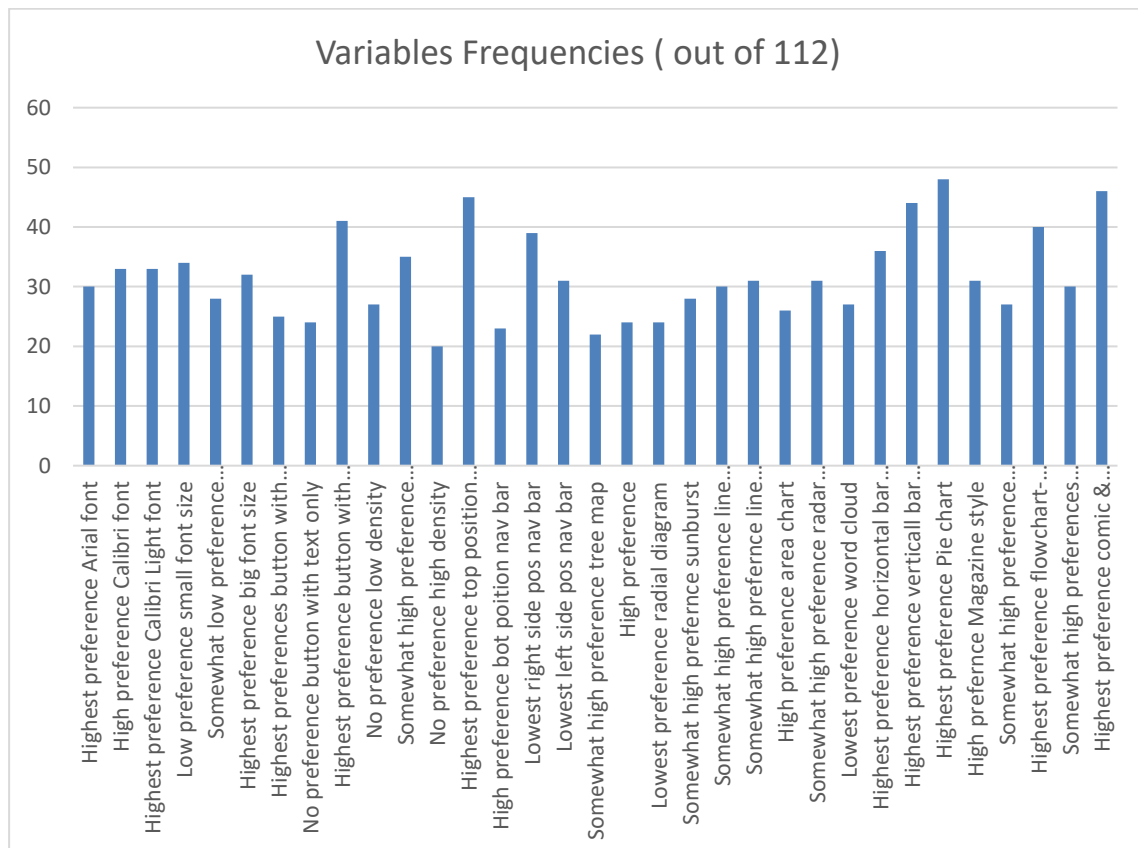


Figure 2. Summary of the majority of participant's visualization type choices

The participants' preferred methods of visualization are shown in Figure 2. The most preferred options by many participants were Arial, Calibri Light, and Calibri fonts, making up the top three selections. Smaller font sizes garnered less support, whereas medium and big font sizes earned moderate and strong support, respectively. Most participants chose buttons with icons over buttons with just text, who were not as popular. Participants' preferences for information density varied; some preferred average density, while others didn't clearly favor high or low densities. The top and bottom placements of the navigation bar received the highest preference, with lesser choices for the right and left places. A significant portion of participants strongly preferred pie charts, horizontal and vertical bar charts, among other visualization options. Other visualization styles, such as word clouds and radial diagrams, received less favor. Overall, these preferences offer insightful information into the study participants' visualization preferences.

An overall comprehension of ranking data is provided by descriptive statistics. They provide a succinct explanation of the ranking data as well as insightful advice on how to proceed with additional data research. Descriptive statistics aid researchers in understanding the features of the data and prospective trends by analyzing the central tendencies, distributions, and variabilities of the rankings [17].

Table 1 Descriptive statistic for personality

	N	Minimum	Maximum	Mean	Std. Deviation
Extraversion	112	1	5	2.76	1.033
Agreeableness	112	1	5	3.05	1.146
Conscientiousness	112	1	5	3.02	1.215
Neuroticism	112	1	5	3.46	1.073
Openness	112	1	5	2.79	1.359
On what device are you filling out this questionnaire?	112	1	3	2.22	.956
Do you have color blindness?	112	1	2	1.97	.162
Valid N (listwise)	112				

Table 2 Descriptive statistic for visualization type elements

	N	Minimum	Maximum	Mean	Std. Deviation
1. Arial	112	1	7	5.17	1.530
2. Calibri	112	1	7	5.42	1.393
3. Calibri Light	112	1	7	4.96	1.847
4. Small font size	112	1	7	2.90	1.781
5. Medium font size	112	1	7	4.37	1.616
6. Big font size	112	1	7	5.26	1.552
7. Button with icon only.	112	1	7	4.77	1.855
8. Button with text only	112	1	7	4.95	1.615
9. Button with icon and with text	112	1	7	5.10	2.022
10. Low density	112	1	7	4.63	1.594
11. Average density	112	1	7	4.98	1.185
12. High density	112	1	7	4.30	1.888
13. Top position of the navigation bar	111	1	7	5.56	1.639
14. Bottom position of the navigation bar	112	1	7	4.24	2.059
15. Right side positioning of the navigation bar.	112	1	7	3.04	1.984
16. Left side positioning of the navigation bar.	112	1	7	3.52	2.152
17. Representation through a Tree map.	112	1	7	4.17	1.999
18. Representation through a Circular Packing diagram.	112	1	7	4.49	1.836
19. Representation through a Sunburst.	112	1	7	4.57	1.819

20. Representation through a Radial diagram	112	1	7	3.47	1.850
21. Representation through a Linechart.	112	1	7	5.21	1.479
22. Representation through a Linechart, with points.	112	1	7	4.89	1.678
23. Representation through an Area chart.	112	1	7	5.08	1.617
24. Representation through a Radar chart	112	1	7	4.89	1.662
25. Representation through a Word Cloud	112	1	7	3.46	1.888
26. Representation through a horizontal bar chart	112	1	7	5.55	1.381
27. Representation through a vertical bar chart	112	1	7	5.81	1.263
28. Representation through a Pie Chart.	112	1	7	5.81	1.379
29. Magazine Style	112	1	7	5.15	1.589
30. Annotated Chart	111	1	7	4.78	1.708
31. Flowchart-Infographic	111	1	7	5.32	1.815
32. Partitioned Poster	112	1	7	5.09	1.680
33. Comic & Animation	112	1	7	5.91	1.212
Valid N (listwise)	109				

The table provides descriptive statistics for preferences in visualization type and personality attributes. The results demonstrate that the sample exhibits low levels of extraversion but average to high levels of conscientiousness, agreeableness, and neuroticism. But openness receives a low rating. Participants strongly like Arial and Calibri fonts, along with large font sizes and buttons that have both text and icons. Information density types are not strongly desired, although the top position for the navigation bar is chosen over the right and left positions. Bar charts, both horizontal and vertical, are frequently used as comparison visualization. Participants object to the usage of word clouds, radial graphs, and small text sizes. Overall, these descriptive statistics provide insightful information on how participants ranked and preferred various personality qualities and study visualization forms.

To assess the association between the five personality traits based on the FFM (extraversion, agreeableness, conscientiousness, neuroticism, and openness) and the visual designs font, Pearson correlation was used. The following tables show the results of correlation between personality trait - neuroticism with the visualization types, that were covered in this research.

Table 3 Correlation between neuroticism and font type

Font type	Correlation
Arial	r = -.020 p = .834
Calibri	r = -.087 p = .363
Calibri light	r = -.026 p = .785

Table 4 Correlation between neuroticism and font size

Font size	Correlation
Small font size	r = -.104 p = .277
Medium font size	r = .048 p = .612
Big font size	r = .085 p = .370

Table 5 Correlation between neuroticism and button type

Button type	Correlation
Button with icon only	r = -.014 p = .881
Button with text only	r = .090 p = .347
Button with icon and text	r = .000 p = 1.00

Table 6 Correlation between neuroticism and density type

Density type	Correlation
Low density	r = .130 p = .172
Average density	r = -.071 p = .454
High density	r = -.171 p = .071

Table 7 Correlation between neuroticism and density type

Position of navigation bar	Correlation
Top navigation bar	r = .013 p = .893
Right navigation bar	r = .181 p = .056
Bottom navigation bar	r = -.079 p = .410
Left navigation bar	r = .174 p = .067

Table 8 Correlation between neuroticism and hierarchical type

Hierarchical type	Correlation
Tree map	r = -.049 p = .608
Circular Packing	r = .018 p = .850
Sunburst	r = -.098 p = .306

Table 9 Correlation between neuroticism and evolution over time type

Evolution over time type	Correlation
Radial diagram	r = .090 p = .344
Line chart	r = -.130 p = .171
Line chart with point	r = .022 p = .815
Area chart	r = -.037 p = .700

Table 10 Correlation between neuroticism and comparison type

Comparison type	Correlation
Radar Chart	r = -.003 p = .977
Word Cloud	r = -.065 p = .494
Vertical bar chart	r = .072 p = .453
Horizontal bar chart	r = .004 p = .969
Pie chart	r = -.155 p = .103

Table 11 Correlation between neuroticism and storytelling types

Storytelling type	Correlation
Magazine style	r = .112 p = .238
Annotated Chart	r = -.064 p = .508
Flowchart-Infographic	r = .057 p = .553
Partitioned Poster	r = -.003 p = .977
Comic & Animation	r = -.059 p = .540

The study finds no evidence of a relationship between neuroticism and any of the types of visualization examined, suggesting that the visualization type used have no effect on people's tendencies for neuroticism. If the p-value is less than 0.05, the Pearson correlation coefficient can be regarded as statistically significant.

5. DISCUSSION

This study investigated whether neuroticism and user preference for visual type might be related. The findings show that neuroticism has no relationship to any sort of visualization. The surprising discovery that people with mental health issues, particularly neuroticism, do not seem to have any trouble selecting visualization kinds is highlighted by this research.

There could be several explanations for the lack of a relationship between visualization type and neuroticism. The first one is a conceptually separate domain from visualization styles and neuroticism. While visualization patterns are related to the display and interpretation of facts, neuroticism represents an individual's emotional stability and propensity to experience negative emotions. There may be no substantial relationship between the two fields, which would explain the apparent lack of a correlation.

Despite the efforts made to ensure the questionnaire's validity and accuracy, there might still be inherent limitations in the data collection process. When evaluating the neuroticism traits, the self-report measures may be affected by individual perceptions or biases. The study's sample size may potentially have had an impact on the outcomes. A more comprehensive picture of the population may have been achieved by using a larger and more diverse sample, which may also have revealed more subtle relationships than those found in this study.

Finally, it is important to acknowledge the complexity of the topic of mental health. Neuroticism, which is merely one aspect of mental health, may not be the sole psychological, cognitive, or other component impacting visualization preferences; other elements may also exist.

CONCLUSION

This study investigated the relationship between various types of visualizations and neuroticism. The lack of a significant association in the analysis suggests that people with mental health issues, particularly those who exhibit neurotic tendencies, do not have difficulties choosing visualization approaches. Future studies should concentrate on how preferences for data interpretation and visualizations are influenced by mental health. By looking at a broader range of mental health dimensions and considering additional visualization, it may be feasible to acquire crucial insights into how individuals with various mental health illness engage with visualization. This might lead to a more tailored and effective visualization reporting, in making important decisions.

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