

Enhancing UEQ Questionnaire Data Visualizations with AttrakDiff Visualization Techniques

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Abstract—The research analyzes how applying AttrakDiff visualization techniques can improve User Experience Questionnaire (UEQ) data representations. Although the UEQ is a commonly used instrument for assessing user experience, the visualizations are can provide more insights. The study adapts AttrakDiff visualizations to UEQ and also proposes new visualizations. According to the study’s findings, participants responded favorably to AttrakDiff-like visualizations’ ability to accurately portray UEQ data. Participants in a sizable majority agreed that the AttrakDiff-like visualizations and proposed ones successfully captured user experience data. The results also showed that the new proposed visuals were simple to comprehend, and most participants praised their clarity.

Index Terms—UEQ, Visualizations, AttrakDiff, User experience evaluation, Questionnaires

I. INTRODUCTION

Questionnaires are a commonly used tool for the user-driven assessment of software quality and usability. They allow an efficient quantitative measurement of product features [1].

AttrakDiff proposed by Hassenzahl, Burmester, and Koller in 2003. It consists of 28 items to be marked by the user, where each item is constructed by a 7-point semantic differential [2]. AttrakDiff can measure the user experience when using a product.

User Experience Questionnaire (UEQ) is one of the questionnaires whose results can be used in usability testing to measure the level of user experience of a product or a system. UEQ enables fast and practical evaluation of user experience with 26 questions [3]. A short version UEQ-S was developed which contains only 8 items. UEQ-S is a good approximation of the UEQ results for pragmatic and hedonic quality [4].

Both UEQ tools help mapping hedonic and pragmatic values of a product and provide multiple benefits like highlighting areas for improvement or mapping multiple user experience variables in summarized results. Having said that, if the questionnaires are interpreted or used inappropriately, it may result in unreliable or invalid results [5].

When used properly, visualizations from the questionnaires can be an effective tool for analyzing data and taking accurate decisions about a product. Improper use can lead to wrong opinions about the product that is been evaluated.

A. Relevance

UEQ and AttrakDiff are two widely used standardized surveys for assessing the user experience of digital products

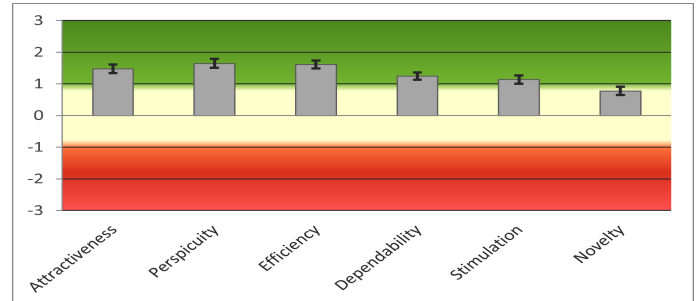


Fig. 1. UEQ visualizations

and services [6]. Mapping UEQ data to AttrakDiff-like visualizations can provide a more natural and approachable way of representing data, resulting in more insights of the user experience.

Since 2017, the UEQ questionnaire has far surpassed AttrakDiff in number of uses [6]. The clarity and utility of the UEQ visualizations need to be improved to make the data analysis process simpler and spot areas where the user experience could be redesigned.

Enhancing UEQ visualizations involves finding ways to present the data in a clear and understandable way, while also providing detailed information and contextual support.

One advantage of mapping UEQ data to AttrakDiff-like visualizations is that is possible to compare user experience evaluations of different products that use AttrakDiff framework and compare them to others that use UEQ processes and vice versa. This increases the overall validity and reliability of user experience ratings.

For companies that use UEQ tools, simplifying the data analysis processes, will result in better overview of the product, which leads to competitive advantage by creating products and services that are more in line with customer requirements and preferences. As a final benefit user satisfaction, where users are more likely to stick with a product or service, which boosts sales and profits.

In the academic area, there are multiple evaluations using UEQ tools [7] [8] [9]. Simplifying the data analysis processes and visualizations, will result in easier evaluation and better suggestions for evaluated software.

B. Challenges

The UEQ data is a complex set of data, which is been processed accurately by the tool to provide insights, nonetheless, the visualizations tend to be complex and unfriendly.

There are some challenges associated with UEQ visualizations. Visualizations can be complex to interpret, and the learning curve can be difficult depending on the audience.

If UEQ visualizations are not created correctly, they can be deceptive and may not accurately reflect the data. As shown in Figure 1, in UEQ using bar charts with just gradient background colors and with no axis descriptions, can help only experimented users of the tool.

UEQ generated results, include a lot of information in one visualization, which results in overly complex, difficult-to-understand visuals.

The proposed approach is to use AttrakDiff-like visualization techniques, which provides more standardized visualizations, making it easier to compare data across different contexts. AttrakDiff-like visualizations can help provide a more intuitive and user-friendly way of presenting user experience data to users of the tool.

AttrakDiff and UEQ share evaluation characteristics such as pragmatic and hedonic evaluations, both of them use similar Likert scales. These facts helps UEQ data be translated to AttrakDiff-like visualizations.

The current research is expected to demonstrate the value of mapping UEQ data to AttrakDiff visualization techniques to simplify data analysis and other proposed visualizations to enhance decision making and standardize visualizations.

The remaining sections of the paper are organized as follows: Section II presents the related work. Section III outlines the methodology and evaluations conducted to test the proposed approach. The results obtained from these evaluations are presented in Section IV. Finally, Section V summarizes the essential findings and their implications.

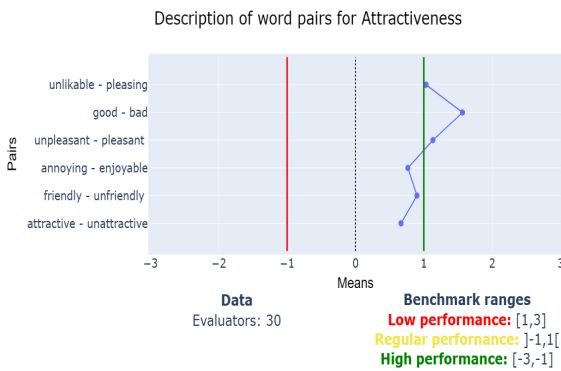


Fig. 2. Average values for pairs sample for attractiveness

II. RELATED WORK

D'Ignazio et al. [10] discusses how visualizations can help users understand, analyze, and communicate big data, in any context. The article argues that visualizations are not only a

way to present data, but also a way to explore, question, and critique data, and that they can foster user engagement, curiosity, and empowerment. The research presents the relevance of simple and efficient visualizations for better understanding of recollected data.

López et al. [6] highlights the use of the User Experience Questionnaire and AttrakDiff, like the tools that have been used the most to measure user experience, especially in Europe. Due to the use of UEQ questionnaire is imperative to improve the provided visualizations, for better understanding of the data.

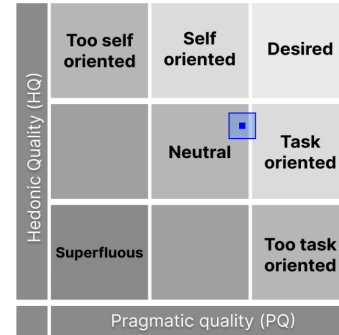


Fig. 3. Confidence chart

Speicher [11], shows AttrakDiff questionnaire is a widely used measure of perceived product attractiveness and includes items related to pragmatic, hedonic, and symbolic aspects of product experience, which gets translated into useful data through visualizations.

Ramírez [8], presents a study that aims to explore the user experience of learning management systems in higher education. The research uses UEQ-S to evaluate the product but shows just one chart related to the data, which makes complex for other readers to understand the complete scope of the data, this evidences the opportunity for improvement in UEQ visualizations.

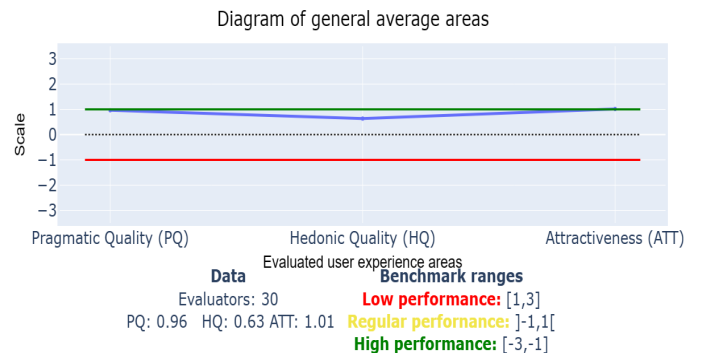


Fig. 4. Average values general

Jhonatan et al. [12] provides a user experience analysis of job searchers' (Pencaker) satisfaction with the Siker application. The User Experience Questionnaire (UEQ) approach was

utilized in the study to collect data on user satisfaction with the application's usability, usefulness, and overall user experience.

III. METHODOLOGY

The research will conduct assessments of the resulting AttrakDiff-like visualizations of the UEQ questionnaire data and other proposed visualizations.

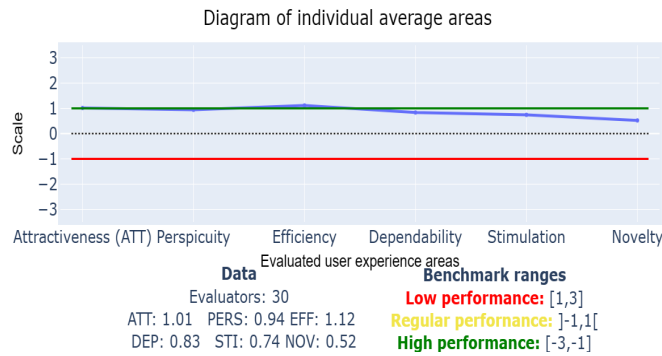


Fig. 5. Average values specific

Since the focus of the research is to improve UEQ and UEQ-S questionnaire data visualizations to simplify data analysis and enhance decision making. The methodology will be split in the next stages:

A. Recollect UEQ data from previous investigations

In order to evaluate the real value of having AttrakDiff-like visualizations and other proposed visualizations with UEQ data, a data example is needed to create the charts. The first step is to recollect data from this evaluation [12], the reason is that this research provides all the raw data from the investigation which makes it reliable for the evaluation.

After the data has been recollect, analyzed the UEQ data using the UEQ online tool, which automatically calculates all the necessary data for the visualizations and displayed them in charts.

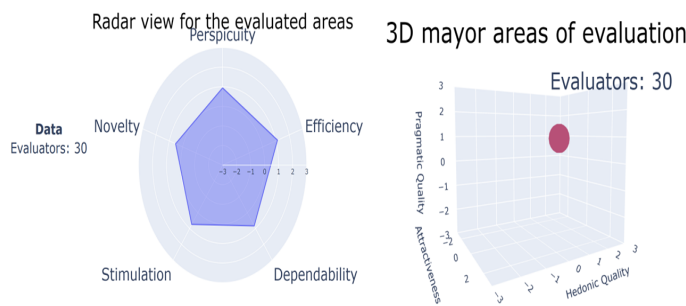


Fig. 6. Radar chart for categories and 3D chart for three main areas

B. Generate visualizations

The next step is to process the process data, to create new visualizations. First, using AttrakDiff visualization techniques, which allows to create a two-dimensional profile of the product

or service based on the pragmatic and hedonic qualities of the UEQ scales. The AttrakDiff-like visualizations to be created are:

- 1) Description of word pairs, figure 2.
- 2) Confidence rectangle (portfolio-presentation), figure 3.
- 3) Diagram of average values for main areas, figure 4.
- 4) Diagram of average values for specific areas, figure 5.

The proposed visualizations to be created are:

- 1) Radar for all the UEQ evaluated areas, figure 6.
- 2) Indicators of UEQ data evaluation, figure 7.
- 3) Heatmap voting distribution for UEQ items, figure 8.
- 4) Candlestick voting distribution for UEQ items, figure 9
- 5) 3D mayor areas of evaluation, figure 6

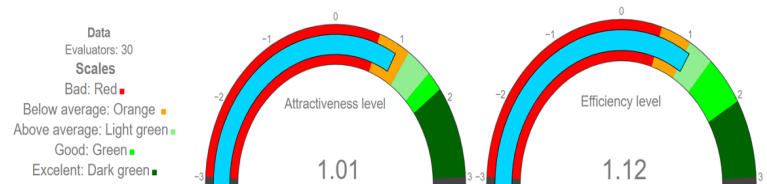


Fig. 7. Indicators for categories Attractiveness and Efficiency samples

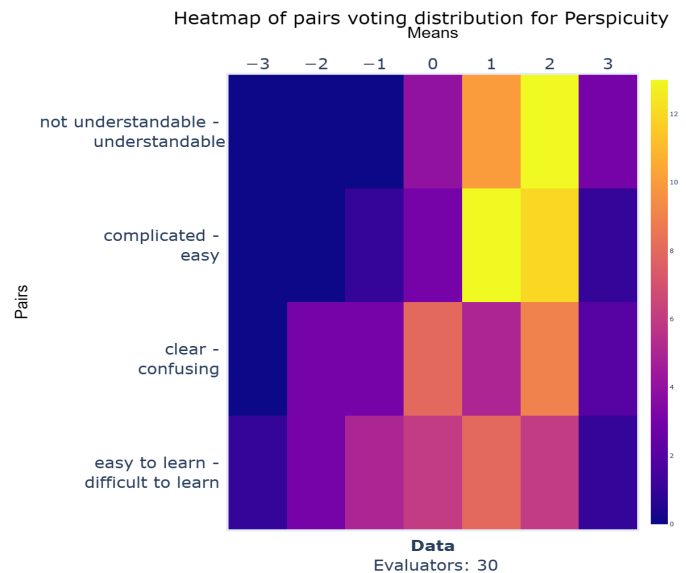


Fig. 8. Heatmap for voting distribution Perspicuity sample

C. Evaluate the visualizations

The visualizations will be evaluated by 23 computer science students focused in software engineering, from Universidad de Costa Rica. The proposed visualizations will be presented and compared with the regular UEQ visualizations. As a next step, a survey will be executed to recollect the desired information from the evaluators.

The survey will have 20 items, divided in 5 areas: AttrakDiff like general evaluation, proposed visualizations general evaluation, specific chart evaluation for AttrakDiff like charts,

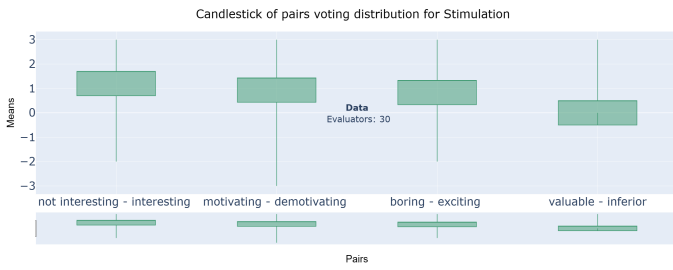


Fig. 9. Candlestick for voting distribution

specific chart evaluation for proposed charts, personal opinion. All evaluated using the Likert scale. The items for the survey that will be applied to the target group are:

- 1) The AttrakDiff-like visualizations: (1) effectively represent the user experience data, (2) are easy to understand, (3) provided new insights into the user experience data, (4) improve my understanding of the user experience data, (5) provide an improvement to the previous UEQ visualizations
- 2) The confidence rectangle, Diagram of average values (general and specific) and Description of word pairs provide an improvement to the previous UEQ visualizations.
- 3) The new Proposed visualizations: (1) effectively represent the user experience data, (2) are easy to understand, (3) provided new insights into the user experience data, (4) improve my understanding of the user experience data, (5) provide an improvement to the previous UEQ visualizations.
- 4) Indicators, heatmap of pair voting distribution, candlestick of pair voting distribution, radar of evaluated areas and 3D mayor areas of evaluation provide an improvement to the previous UEQ visualizations.
- 5) Personal opinion: I would prefer to use the new visualizations of the UEQ data in future studies, I am likely to recommend the new visualizations to other researchers or practitioners in the field of HCI.

D. Analyze results

Analyze the metrics from the survey results, to determine the validity and reliability of the proposed visualizations, at the same time, analyze the feasibility of implementing the visualizations official in the UEQ online tool.

IV. RESULTS

According with the Figure 10, 67.7% of the polled individuals agreed that the AttrakDiff-like visualizations effectively represent the user experience data. The 33.3% of the respondents strongly agreed with this statement. The 75% of the polled individuals agreed that the visualizations are easy to understand. The majority of the participants found the AttrakDiff-like visualizations to be clear and comprehensible, facilitating their interpretation and analysis of the user experience data.

The 66.7% of the polled individuals agreed that the visualizations provided new insights into the user experience data. The 16.7% of the respondents strongly agreed with this statement. This indicates that a significant portion of the participants found the AttrakDiff-like visualizations to be valuable in uncovering fresh perspectives about user experience.

The 100% of the participants agreed that the visualizations improved their understanding of the user experience data. This implies that every individual who took part in the poll found the AttrakDiff-like visualizations to be effective in enhancing their comprehension.

The 91.7% of the polled individuals agreed that the AttrakDiff-like visualizations are an improvement over the original UEQ visualizations. Among them, 50% agreed, while 41.7% strongly agreed.

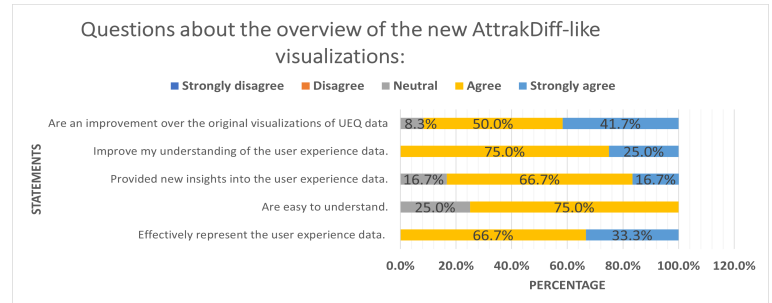


Fig. 10. Overview AttrakDiff like visualizations evaluation

According to the Figure 11:

- 1) **Confidence rectangle:** The 50% of the polled individuals hold a neutral opinion regarding the improvement of the Confidence Rectangle visualization compared to the original UEQ visualizations. The 41% of the respondents agree that there is an improvement. The 8% of the participants strongly agree with the enhancement. The results indicate a lack of consensus among the participants regarding the effectiveness of the Confidence Rectangle visualization, with an equal number of individuals expressing neutral opinions as those who agree or strongly agree with the improvement.
- 2) **Diagram of Average Values:** The 63.6% of the polled individuals agree that there is an improvement in the Diagram of Average Values visualization. The 18.2% of the respondents hold a neutral opinion. Another 18.2% of the participants strongly agree with the improvement. The majority of the participants (63.6%) perceive an enhancement in the Diagram of Average Values visualization, while a smaller proportion express a neutral stance. Additionally, a notable portion strongly agrees with the improvement, indicating a positive reception overall.
- 3) **Description of word pairs:** The 41% of the polled individuals agree that there is an improvement in the Description of Word Pairs visualization. The 25% of the respondents also agree with the improvement. However, 33% of the participants hold a neutral stance toward the

improvement. The findings demonstrate a divided opinion among the participants, with a significant number expressing neutrality and a relatively smaller proportion agreeing with the enhancement.

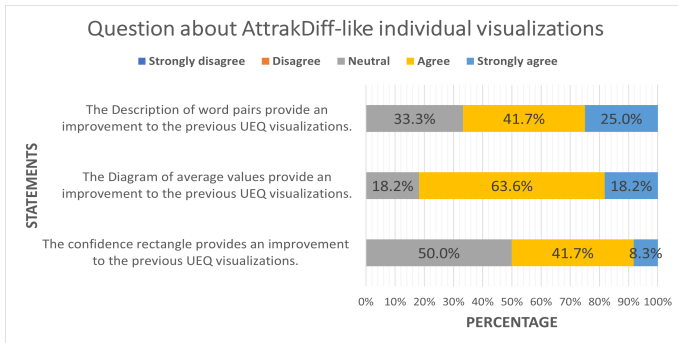


Fig. 11. Individual AttrakDiff like visualizations evaluation

According to Figure 12, the main insights are, 66.7% of the polled individuals agree that the new visualizations effectively represent the user experience data. Additionally, 33.3% of the respondents strongly agree with this statement. This shows that there was a significant consensus among the participants that the new visualizations were successful in correctly displaying the user experience data, with the majority of them agreeing. The 75% of the polled individuals agree that the new visualizations are easy to understand. Also 25% of the respondents also agree with this statement.

The findings show that participants had a favorable opinion of the new visualizations, with the majority of them being easy for them to understand. The 66.7% of the polled individuals agree that the new visualizations provide new insights into the user experience data. Another 16.7% of the respondents strongly agree with this statement. However, 16.7% of the participants express a neutral stance. The findings suggest that a significant majority recognizes the value of the new visualizations in offering fresh perspectives and understanding of the user experience data, although there is a small proportion that remains neutral in this regard.

On the other hand, 58.3% of the polled individuals agree that the new visualizations improve their understanding of the user experience data, 25% of the respondents strongly agree with this statement. The 16.7% of the participants express a neutral opinion. The results indicate a positive perception among the majority, acknowledging the improvement in understanding the user experience data through the new visualizations, although a proportion remains neutral.

Finally 58.3% of the polled individuals agree that the new visualizations are an improvement over the original UEQ and AttrakDiff visualizations. Additionally, 16.7% of the respondents express a neutral stance. The findings suggest a positive reception among the majority, perceiving the new visualizations as an enhancement over the previous visualizations used, with a proportion remaining neutral.

According with the Figure 13 here are some insights from the new proposed visualizations.

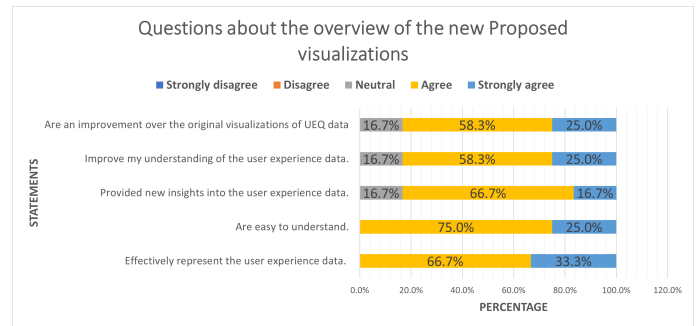


Fig. 12. Overview Proposed visualizations evaluation

- 1) **Indicators:** The 83.3% of the polled individuals agree that there is an improvement in the indicators compared to the original UEQ visualizations. The 8.3% of the respondents strongly agree with the enhancement. The 8.3% of the participants hold a neutral opinion. The results indicate a strong consensus among the participants, with a large majority expressing agreement or strong agreement with the improvement in the indicators.
- 2) **Heatmap of pair voting distribution:** The 41% of the polled individuals hold a neutral opinion regarding the improvement of the Heatmaps of Pair Voting Distribution visualization. The 33% of the respondents agree that there is an improvement. The 25% of the participants strongly agree with the enhancement. The findings suggest a split opinion among the participants, with a significant proportion expressing neutrality, but a sizable portion also agreeing or strongly agreeing with the improvement in the heatmap.
- 3) **Candlestick of pair voting distribution:** The 41% of the polled individuals hold a neutral opinion regarding the improvement of the candlestick of pair voting distribution visualization. The 41% of the respondents agree that there is an improvement. The 16.7% of the participants strongly agree with the enhancement. The results indicate a divided opinion among the participants, with an equal number expressing neutrality or agreement, and a smaller portion strongly agreeing with the improvement in the candlestick visualization.
- 4) **3D mayor areas of evaluation:** The 18.3% of the polled individuals disagree with the improvement in the 3D Mayor Areas of Evaluation visualization. The 45% of the respondents agree that there is an improvement. The 36.4% of the participants strongly agree with the enhancement. There is a notable portion that disagrees with the improvement.
- 5) **Radar of evaluated areas:** The 30% of the polled individuals hold a neutral opinion regarding the improvement of the radar of evaluated areas visualization. The 40% of the respondents agree that there is an improvement. The 30% of the participants strongly agree with the enhancement. The results indicate a balanced response among the participants, with equal proportions

expressing neutrality, agreement, and strong agreement with the improvement in the radar visualization.

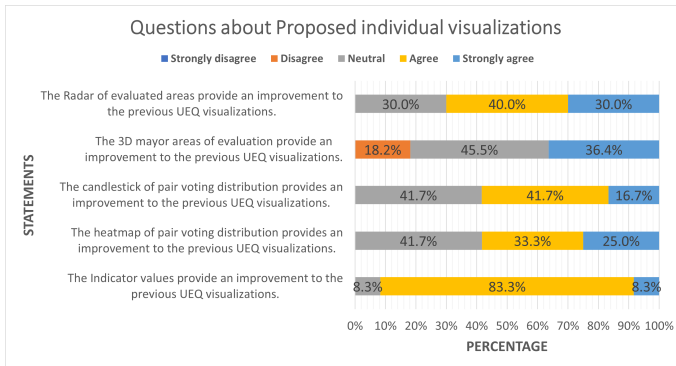


Fig. 13. Individual proposed visualizations evaluation

For the personal actions after checking the visualizations, the Figure 14 has some insights. The 41.7% of participants agree that they would prefer to utilize the updated UEQ data visualizations in future investigations. Another 41.7% strongly agree with this assertion. Only 16.7% of those polled are undecided. The results show that a considerable majority (83.4%) of participants either agree or strongly agree that they would use the new visualizations in future research, indicating a high degree of preference for these representations. The 33.3% of participants agreed that they would suggest the new visuals to other HCI researchers. Another 33.3% strongly support this suggestion. Only 33.3% of those polled have a neutral opinion. According to the findings, the majority of participants (66.6%) either agree or strongly agree with recommending the new visuals to other academics in the area, indicating a good endorsement of these visualizations.

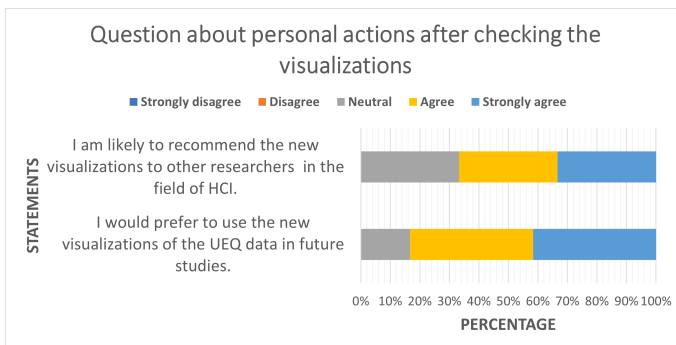


Fig. 14. Personal perspectives for new visualizations

V. CONCLUSION AND FUTURE WORK

The survey findings show that respondents strongly approve of the new UEQ data visualizations (AttrakDiff like and proposed ones).

The results show a high degree of acceptance and trust in the efficacy and utility of the new visualizations, for both individual usage and for furthering domain-specific research.

The survey results demonstrate a positive reception of the AttrakDiff-like visualizations in enhancing the UEQ visualizations. The visualizations were widely perceived as effective, easy to understand, and capable of providing new insights into the user experience data. These findings highlight the potential of the AttrakDiff-like visualizations to enhance the analysis and understanding of UEQ user experience data.

The proposed visualizations are also recognized as an improvement over the original UEQ and AttrakDiff visualizations, although there is a notable proportion expressing neutrality in certain aspects. These findings highlight the potential of the new visualizations in enhancing the analysis and understanding of UEQ user experience data as well. The 3D mayor areas, will be rejected since does not provide a significant value.

There is a challenge into mapping the hedonic quality from the AttrakDiff (Identity, Stimulation) to UEQ because UEQ does not manage this division explicitly.

For future work, the new visualizations will be presented to the authors of UEQ, with the goal to integrate them to the online tool.

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