V-RECS TEACHERS' PROMPTS TEMPLATE DESCRIPTION

This appendix provides further details regarding the teachers' prompt templates and the aggregation strategy for combining all the responses generated, extending the content of Section 5.

Each Teacher is designated with a unique input and task, detailed in Table I that we replicate here for the reader's convenience.

TABLE I: Description of the Teacher's tasks

Task	Input	Goal	Description
T1	Query, VegaZero, Dataset	*Explain*	Explain to the user why the features used in VegaZero are the most appropriate given all the dataset features and the user's query
T2	VegaZero	*Caption*	Caption of the visualization
T3	VegaZero	*Suggest*	Discover the most insightful questions to suggest to the user for exploring the data

A. Teacher's template

Within the CoT zero-shot configuration, every teacher prompt comprises a series of steps, which serve as guiding cues for the model, steering it toward a specific direction instead of operating unthinkingly. The sequence of these steps, denoted as S_i, guides the model toward the intended solution. All Teachers' prompt templates encompass the primary task, the VegaZero template, and the steps.

Each Teacher is delineated as follows:

- T1 - Goal: Explain. This Teacher (Figure 1) is assigned three main requests(i.e., steps). In the first step S_1, the model is prompted to extract the X and Y columns from the VegaZero specification. The second step, S_2, rephrases the user query to enhance the model's comprehension. Finally, in the last step S_3, once the initial two steps are completed, the model is tasked with explaining why the selected columns for X and Y are chosen based on all others, considering the user query.

- T2 - Goal: Caption. In contrast to T1, T2 (Figure 2) requires only the VegaZero specification as input. The initial step S_1 revolves around data extraction, focusing on X, Y, and aggregation columns specified in the VegaZero template. Subsequently, the second step S_2 prompts the model to identify the structural properties of the visualization, such as color and grouping functions. Lastly, once equipped with a comprehensive understanding of the visualization structure, the final step S_3 directs the model to generate a caption of the visualization, based on all extracted information.

- T3 - Goal: Suggest. For this Teacher (Figure 3), the initial step S_1 involves understanding the mathematical function responsible for axis transformation and providing context regarding column transformation types. In the subsequent step, S_2, the model is asked to generate data exploration questions considering the features and mathematical functions. Lastly, the final step S_3 tasks the model with suggesting further questions to explore additional visualization properties, aiming to provide insightful visualizations.

B. Responses aggregation

The last step is to aggregate the answers to create the final prompt to fine-tune the Student, as described in the paper (see Figure 4 in the paper). Not all the responses R_i are used for each Teacher. As

discussed, the S_i provides cues to the model toward a solution; for this reason, some steps help the model create a context to produce the final response. The final prompt keeps from R1 the S_1 and S_3, where S_1 provide the information of the columns selected as described and S_3 the explanation of why they are the best. From R2, we select S_2 and S_3, where S_2 decomposes the VegaZero structural properties (i.e., color, aggregation function) and S_{i3} is the description of the visualization. Finally, from R3, we keep the S_1, the math operation involved in generating the visualization, and S_3 the suggestion of additional data queries. All this information is mapped in coherent and meaningful sequence in the prompt template, which incrementally provides the information needed by the Student to understand gradually all the steps required to generate the visualization and the related narrative.

A Let's generate an explanation step by step.

B Consider the input template to be the following:
mark [T] encoding x [X] y aggregate [AggFunction][Y] color [Z] transform filter [F] group [G] bin [B] sort [S] topk [K]

Step 1. Extract the input [X] and [Y] values based on the provided template. Refer to this: {VEGAZERO}
Step 2. Based on their request, Explain what the user is looking for in the dataset. Refer to this user request: {QUERY}
Step 3. Explain why the features selected are the best among all the others from the dataset based on the user request. Refer to this dataset: {DATASET}

C ##
Step 1. Columns selections:
- X-axes [X]:
- Y-axes [Y]:
- Transform filter [F] and [G]:
Step 2 (E1). Exaplanation part 1:
Step 3 (E2). Exaplanation part 2:

Fig. 1: Structure of the T1 prompt.

A {VEGA_ZERO}

Let's generate question(s) step by step.

B Consider the input template to be the following: mark [T] encoding x [X] y aggregate [AggFunction][Y] color [Z] transform filter [F] group [G] bin [B] sort [S] top [K]

Step 1. What is the mathematical operation(s) (e.g., max, min, sum, difference, and average) required to describe the feature?
Step 2. Generate question using the mathematical operation required to describe the feature.
Step 3. Generate suggestion(s) to help the user focus on some interesting insights from the chart

C ##
Step 1. Operations:
Step 2. Questions:
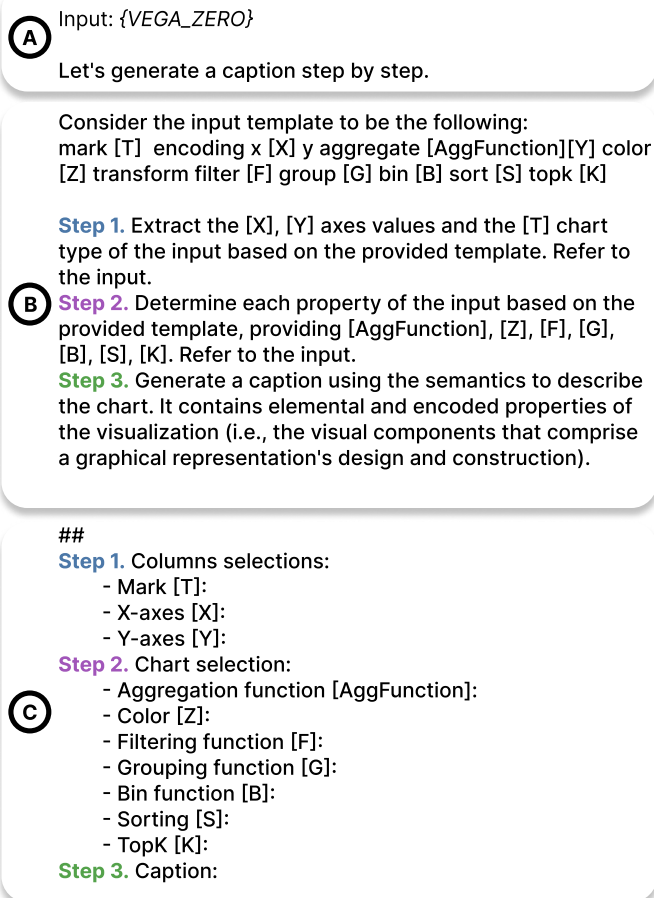**Step 3.** Suggestions:

Fig. 2: Structure of the T2 prompt.

A Input: *{VEGA_ZERO}*

Let's generate a caption step by step.

B Consider the input template to be the following:
mark [T] encoding x [X] y aggregate [AggFunction][Y] color [Z] transform filter [F] group [G] bin [B] sort [S] topk [K]

Step 1. Extract the [X], [Y] axes values and the [T] chart type of the input based on the provided template. Refer to the input.

Step 2. Determine each property of the input based on the provided template, providing [AggFunction], [Z], [F], [G], [B], [S], [K]. Refer to the input.

Step 3. Generate a caption using the semantics to describe the chart. It contains elemental and encoded properties of the visualization (i.e., the visual components that comprise a graphical representation's design and construction).

C ##
Step 1. Columns selections:
   - Mark [T]:
   - X-axes [X]:
   - Y-axes [Y]:
Step 2. Chart selection:
   - Aggregation function [AggFunction]:
   - Color [Z]:
   - Filtering function [F]:
   - Grouping function [G]:
   - Bin function [B]:
   - Sorting [S]:
   - TopK [K]:
Step 3. Caption:

Fig. 3: Structure of the T3 prompt.

APPENDIX B
V-RECS QUALITATIVE RESULTS

In this document, we report additional analysis results from our user evaluation, providing more detailed results in terms of the effect of query difficulty on the informativeness and utility measured from both V-RECS and GPT-4.

A. Explanation

Overall evaluation of the Explanation narrative (E).
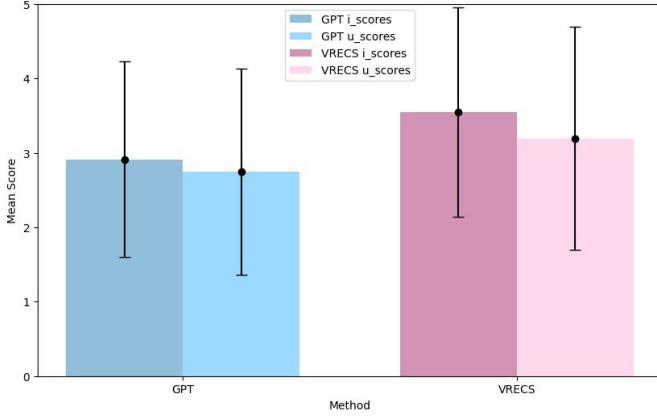
Fig. 4: Explanation evaluation

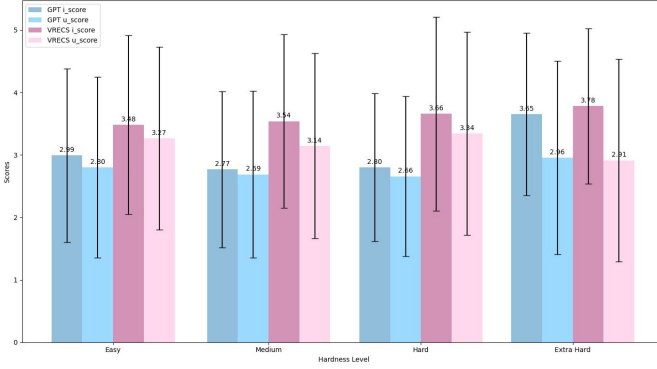Break down of the Explanation narrative evaluation for the different query difficulty levels.

Fig. 5: Explanation evaluation per query hardness levels

B. Caption

Overall evaluation of the Caption narrative (C). Break down of the Caption narrative evaluation for the different query difficulty levels, see Figure 6 and Figure 7.
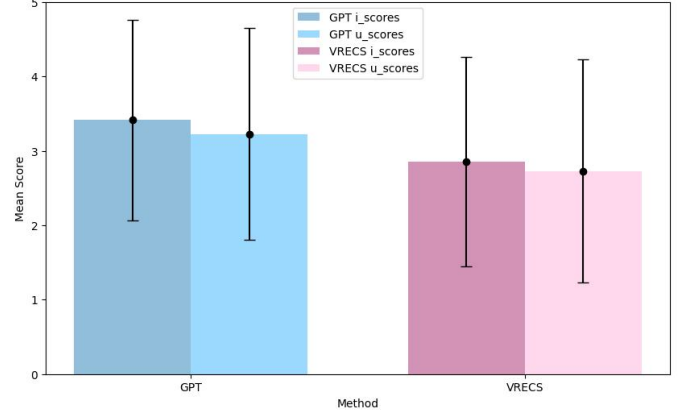
Fig. 6: Caption evaluation
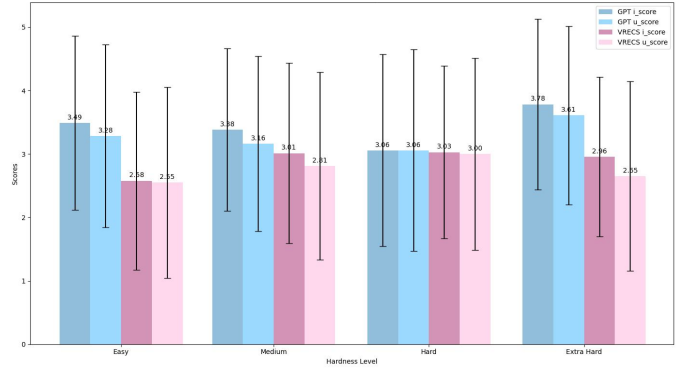
Fig. 7: Caption evaluation per query hardness levels

C. Suggestions

Overall evaluation of the Suggestions narrative (S).
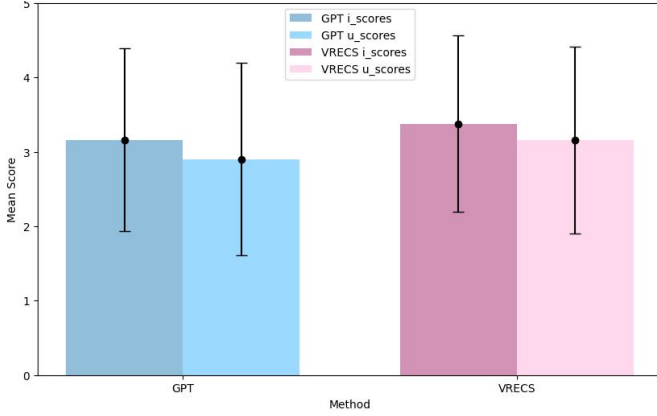
Fig. 8: Suggestions evaluation

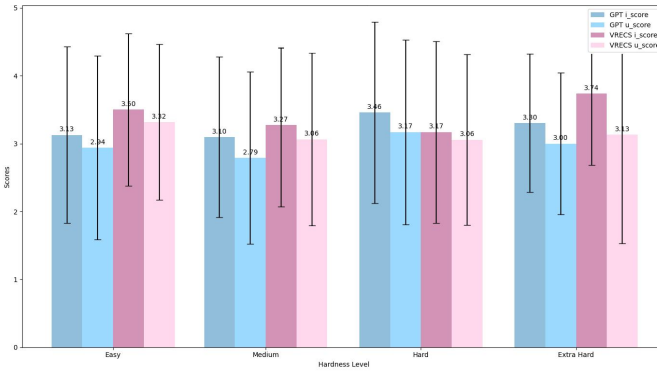Break down of the Suggestions narrative evaluation for the different query difficulty levels.

Fig. 9: Suggestions evaluation per query hardness levels

D. Global Narrative

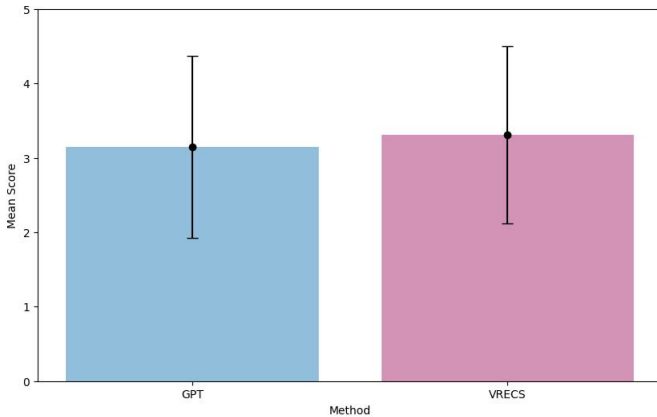Evaluation of the overall Narrative utility.

Fig. 10: Narrative (overall) evaluation

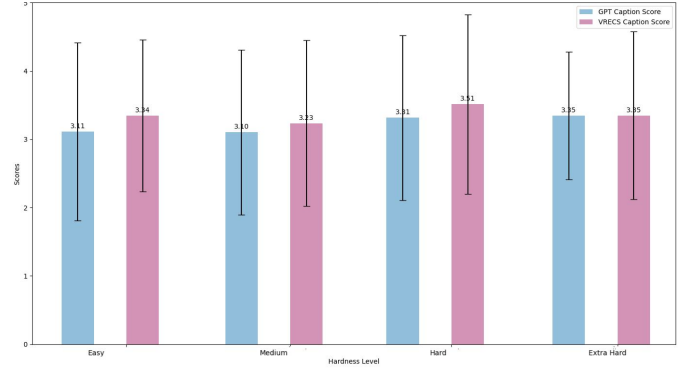Break down of the overall narrative evaluation for the different query difficulty levels.

Fig. 11: Narrative (overall) evaluation per query hardness levels

E. Visualization

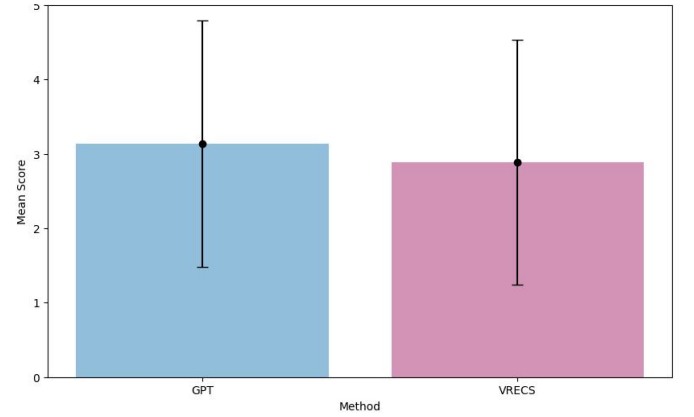Evaluation of the generated visualizations quality.

Fig. 12: Visualization

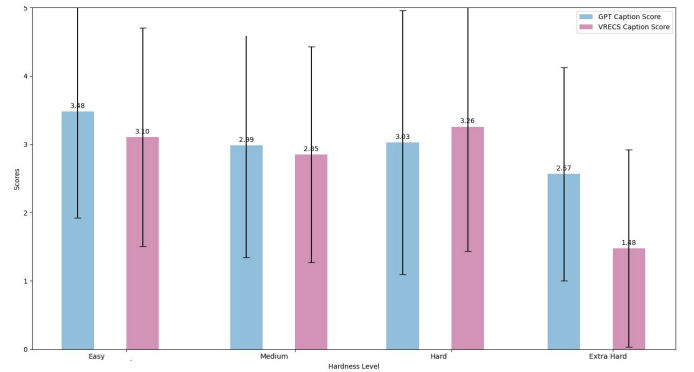Break down of the generated visualizations evaluation for the different query difficulty levels.

Fig. 13: Visualization evaluation per query hardness levels