SUPPLEMENTAL MATERIAL
Chart Selection Criteria and Dataset Description

Our dataset contains 60 SVG visualization examples, 40 of which are used exclusively for training and 20 for testing. This supplementary material documents our dataset construction methodology, graph selection criteria, theoretical complexity analysis framework, test dataset statistics to support evaluation methods, and a questionnaire annotation system for manually annotating these datasets.

I. Dataset Collection

A. Source Selection and Coverage

We collected charts from three authoritative platforms: D3.js official examples (industry-standard interactive visualizations), Highcharts gallery (professional charting samples), and Plotly examples (cross-platform references). This multi-platform approach ensures diversity across real-world visualization practices and follows established perceptual guidelines [1].

Our chart selection follows established visualization taxonomy based on *A Guide to Choosing the Right Chart Type* [2]. Table I presents the comprehensive categorization framework that guided our dataset construction, ensuring systematic coverage across fundamental data relationship types.

TABLE I
CHART TAXONOMY AND COVERAGE FRAMEWORK

Data Type	Corresponding Chart Types
Time Series	Curve chart, Double-scale curve, Column chart, Surface chart, Step chart
Parts of Whole	Pie chart, 100% column chart, 100% bar chart
Multiple Objects	Bar chart, Column chart, Sorted bar, Floating bar, Patch map, Pictogram
Variable Relations	Scatter plot, Scatter-and-line plot, Dual bar, Pyramid chart, Curve chart

B. Rationale for Removing legend and axis labels

Prior to feature extraction and complexity analysis, we manually removed numerical axes, coordinate grids, and legends from every collected SVG file. This preprocessing step is motivated by two complementary considerations:

1) **Visualization simplification.** Although axes and legends are indispensable for human interpretation, their concrete visual forms (tick styles, label density, legend placement, etc.) vary substantially across charting libraries. These variations contribute little to the geometric or topological structure that determines the saliency of data patterns. Removing them therefore reduces annotation effort, alleviates model learning burden, and allows the remaining visual bandwidth to be devoted to core graphical primitives (bars, lines, areas, nodes, links, *etc.*).
2) **Enhanced pattern perception.** In interactive studies of pattern saliency, auxiliary annotation elements can distract attention away from the key visual patterns of interest. Eliminating axes and legends encourages both human observers and automated models to focus on the intrinsic shapes and spatial arrangements that convey the underlying data relationships, thereby improving the sensitivity of subsequent complexity evaluation.

This simplification strategy follows the principle of isolating essential visual signals while discarding redundant decorations, ultimately leading to a cleaner dataset and more robust assessment of pattern salience.

C. Complexity-based Selection

After collecting a large amount of SVG data and preprocessing them to remove the axes and legends, we selected them by Chart complexity. Chart complexity is defined through visual element count (graphical primitives), visual channel count (encoding dimensions), and integrated complexity score (weighted combination based on cognitive load theory [4]). For the training set, we used uniform sampling, taking approximately 25% of the samples in each of the low, medium, high, and very high complexity levels to ensure balanced representation. However, for the test set, we deliberately employed non-uniform sampling with intentional bias toward higher complexity levels (40% highly complex vs 22.5% in training) to create a more challenging evaluation scenario that better assesses model performance under demanding conditions and provides stronger discriminative power for algorithm comparison.

Additionally, we performed quality assurance to filter out charts with overlapping elements, inconsistent data-visual mappings, excessive cognitive load, and perceptual validity issues. Color encoding strategies include monochromatic, analogous, complementary, sequential, and diverging schemes to enhance generalization [3].

D. Theoretical Complexity Framework

Our framework integrates established theories from cognitive science and perceptual psychology [1], [4], [5].

Cleveland-McGill Perceptual Hierarchy [1]: Different visual encodings receive accuracy-based weights:

$$\begin{aligned} w_{\text{position}} = 1.0, \quad w_{\text{length}} = 1.2, \quad w_{\text{angle}} = 1.8 \\ w_{\text{area}} = 2.4, \quad w_{\text{color}} = 3.2 \end{aligned} \tag{1}$$

Cognitive Load Theory [4]: Based on working memory limitations:

$$C_{\text{cognitive}} = \begin{cases} 0 & \text{if } n \leq 4 \\ \left(\frac{n-4}{4}\right)^{1.5} \times 3.0 & \text{if } n > 4 \end{cases} \tag{2}$$

Stevens' Power Law [5]: For color perception complexity:

$$C_{\text{color}} = n_{\text{color}}^{0.4} \times 2.5 \times 1.5 \tag{3}$$

Integrated Score: Final complexity combines all dimensions:

$$C_{\text{total}} = C_{\text{element}} \times 1.0 + C_{\text{channel}} \times 2.0 + C_{\text{color}} \times 1.5 + C_{\text{cognitive}} \times 3.0 + C_{\text{transform}} \times 1.2 \tag{4}$$

II. Dataset Description

A. Training and Test Set Comparison

Figures 1 and 2 provide detailed visualization of complexity distributions across both datasets, showing significant complexity differences between training and test sets. The test set exhibits higher mean complexity (934.5 vs 463.3, p¡0.001) and greater emphasis on challenging visualizations, validating our evaluation design.

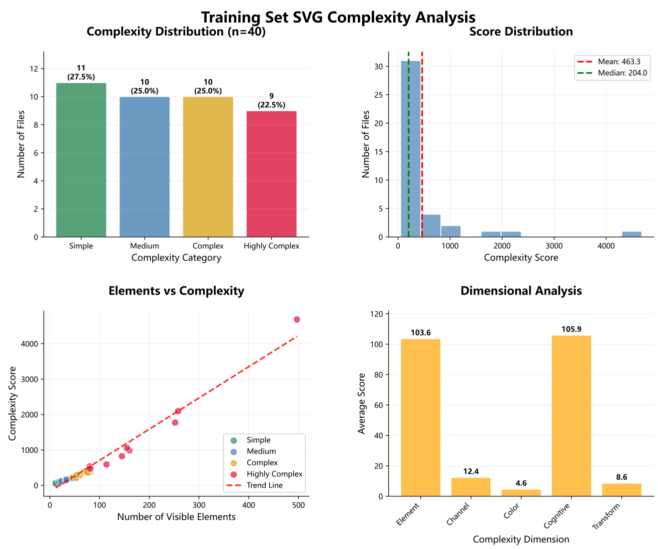

Fig. 1. Training Set Complexity Analysis: Distribution of complexity scores across chart types showing balanced representation across difficulty levels.

1) File-by-File Description: Tables III and II provide comprehensive complexity analysis for all 60 dataset files. The training set demonstrates complexity scores ranging from 50.8 to 4,684.0 points across diverse chart types, ensuring balanced coverage across difficulty levels. The test set strategically emphasizes challenging visualization scenarios with complexity scores reaching up to 6,627.5 points, providing robust evaluation benchmarks.

2) Dataset Overview: The complete dataset comprises 60 carefully curated visualization examples distributed across training and test sets with deliberate complexity stratification. Detailed visual documentation of all dataset components is provided in the visual examples section below for comprehensive reference.

3) Questionnaire Annotation System: Figure 3 to 6 illustrates the four key screens of our web-based questionnaire annotation platform. The workflow is as follows:

1) **Landing page (Fig. 3).** Annotators first enter their personal information (completely confidential) and select their level of proficiency in creating visualizations. This step generates a unique session token used to track progress for each annotator.
2) **Interactive novice guide (Fig. 4).** Annotators then learn how to use the annotation system through an interactive step-by-step onboarding tutorial.
3) **Annotation interface (Figure 5).** After completing the novice guide, the annotator officially enters the annotation interface. The left upper panel dynamically renders the target SVG visualization effect, while the annotator selects elements through the lower left panel (supports box selection and sliding selection), and the right panel displays the elements used for group creation, existing elements in the group, and perceived complexity scores. The progress bar at the bottom indicates the remaining tasks (the data that each annotator needs to annotate is 10 SVG examples randomly selected from

Fig. 2. Test Set Complexity Analysis: Distribution emphasizing higher complexity scenarios with 40% highly complex visualizations for rigorous evaluation.

TABLE II
Test Set Complete Analysis

File	Category	Elem.	Ch.	Score	Chart Type
1.svg	Complex	70	7	391.6	Complex
2.svg	Medium	36	4	136.6	Standard
3.svg	Highly Complex	201	3	1752.6	High Complex
4.svg	Complex	64	4	332.2	Path Chart
5.svg	Medium	22	3	102.3	Standard
6.svg	Medium	29	3	136.5	Standard
7.svg	Highly Complex	332	3	3304.1	Path Chart
8.svg	Highly Complex	169	3	1195.8	Path Chart
9.svg	Simple	14	5	84.1	Basic Chart
10.svg	Highly Complex	589	3	6627.5	Path Chart
11.svg	Medium	21	3	103.5	Standard
12.svg	Medium	25	4	127.9	Standard
13.svg	Medium	30	4	146.9	Standard
14.svg	Medium	34	5	175.5	Network
15.svg	Highly Complex	171	3	1214.1	Path Chart
16.svg	Highly Complex	130	6	767.5	Network
17.svg	Highly Complex	145	5	953.0	Network
18.svg	Complex	74	5	374.6	Complex
19.svg	Complex	43	3	213.1	Path Chart
20.svg	Highly Complex	97	4	550.1	Complex

Summary: Mean Elements: 114.8, Mean Score: 934.5

TABLE III
TRAINING SET COMPLETE ANALYSIS

File	Category	Elem.	Ch.	Score	Chart Type
1.svg	Complex	81	4	366.3	Scatter Plot
2.svg	Complex	77	4	347.4	Dense Bar
3.svg	Highly Complex	252	4	1772.5	Dense Bar
4.svg	Simple	17	4	64.2	Basic Chart
5.svg	Medium	52	2	201.5	Standard
6.svg	Medium	32	3	143.0	Standard
7.svg	Simple	12	4	50.8	Basic Chart
8.svg	Simple	19	3	93.0	Color-Rich
9.svg	Medium	34	3	163.2	Path Chart
10.svg	Simple	15	4	81.0	Basic Chart
11.svg	Complex	70	3	386.5	Path Chart
12.svg	Highly Complex	497	4	4684.0	Dense Bar
13.svg	Complex	46	5	212.1	Multi-Variate
14.svg	Simple	15	4	62.4	Basic Chart
15.svg	Highly Complex	80	5	533.3	Complex
16.svg	Medium	46	2	187.3	Standard
17.svg	Simple	18	4	91.1	Basic Chart
18.svg	Complex	73	4	394.0	Path Chart
19.svg	Highly Complex	258	4	2093.8	Path Chart
20.svg	Highly Complex	81	4	468.7	Path Chart
21.svg	Medium	25	4	94.9	Standard
22.svg	Simple	15	4	62.9	Basic Chart
23.svg	Complex	53	4	216.7	Complex
24.svg	Simple	15	5	92.7	Basic Chart
25.svg	Medium	19	4	98.9	Color-Rich
26.svg	Highly Complex	145	4	822.6	Tree Map
27.svg	Complex	70	4	384.8	Path Chart
28.svg	Highly Complex	160	3	988.8	Tree Map
29.svg	Simple	16	5	73.3	Basic Chart
30.svg	Medium	44	5	206.4	Multi-Variate
31.svg	Simple	14	4	77.0	Basic Chart
32.svg	Complex	61	5	282.2	Complex
33.svg	Highly Complex	155	3	1054.3	Bubble
34.svg	Complex	54	5	294.1	Network
35.svg	Highly Complex	114	3	587.8	Dense Bar
36.svg	Medium	24	5	129.2	Multi-Variate
37.svg	Complex	75	4	366.0	Complex
38.svg	Medium	23	4	110.9	Standard
39.svg	Medium	33	5	129.5	Bubble
40.svg	Simple	12	3	63.6	Color-Rich

Summary: Mean Elements: 72.5, Mean Score: 463.3

the dataset).

4) **Submission confirmation (Figure 6).** After each submission, the system will upload the data to the server for processing. Annotators will receive immediate feedback and receive compensation based on their unique session token.

All collected annotations are aggregated into a CSV file and processed into a special format for downstream analysis and model training.

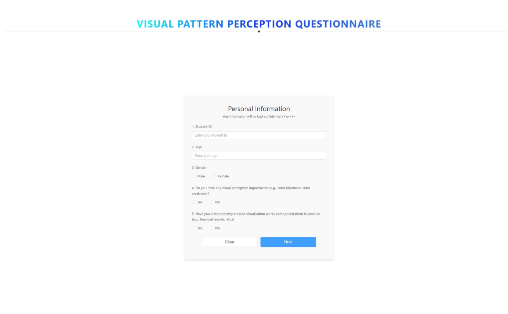

Fig. 3. Landing page of the questionnaire annotation system.

Fig. 4. Interactive novice guide of the questionnaire annotation system.

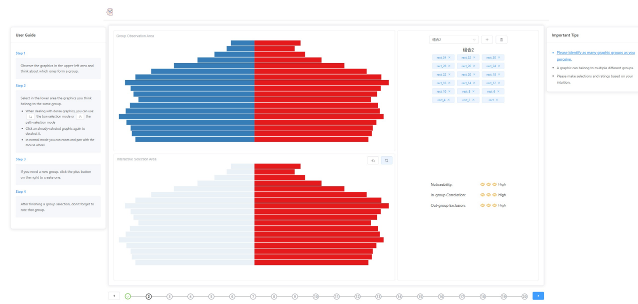

Fig. 5. Annotation interface of the questionnaire annotation system.

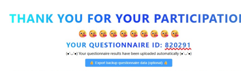

Fig. 6. Submission confirmation screen of the questionnaire annotation system.

REFERENCES

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Initial Annotation Data Format

The following is an example of the initial annotation data format in JSON, which describes the initial data structure for the questionnaire annotation system, including basic information, annotation steps, groups, and their ratings.

```
{
  "formData": {
    "studentid": "studentid",
    "age": "age",
    "gender": "gender",
    "visualimpairment": "yes/no",
    "visualizationExperience": "yes/no",
    "id": "unique session token"
  },
  "startTime": "startTime",
  "endTime": "endTime",
  "duration": "duration (endTime - startTime) in seconds",
  "steps": [
    {
      "stepId": stepId (corresponding absolute id in the dataset),
      "groups": [
        {
          "group": "group_1",
          "nodes": ["rect_10", "circle_7", "rect_1", "rect_4"],
          "ratings": {
            "attention": 3,
            "correlation_strength": 2,
            "exclusionary_force": 1
          }
        },
        {
          "group": "group_2",
          "nodes": ["path_2", "rect_5", "rect_8", "rect_11"],
          "ratings": {
            "attention": 2,
            "correlation_strength": 2,
            "exclusionary_force": 2
          }
        },
        {
          "group": "group_3",
          "nodes": ["path_9", "circle_6", "path_3", "path"],
          "ratings": {
            "attention": 3,
            "correlation_strength": 2,
            "exclusionary_force": 1
          }
        },
        {
          "group": "group_4",
          "nodes": ["rect_10", "path_7"],
          "ratings": {
            "attention": 3,
            "correlation_strength": 2,
            "exclusionary_force": 1
          }
        }
      ]
    }
    // ... (subsequent group data)
  ]
}
```

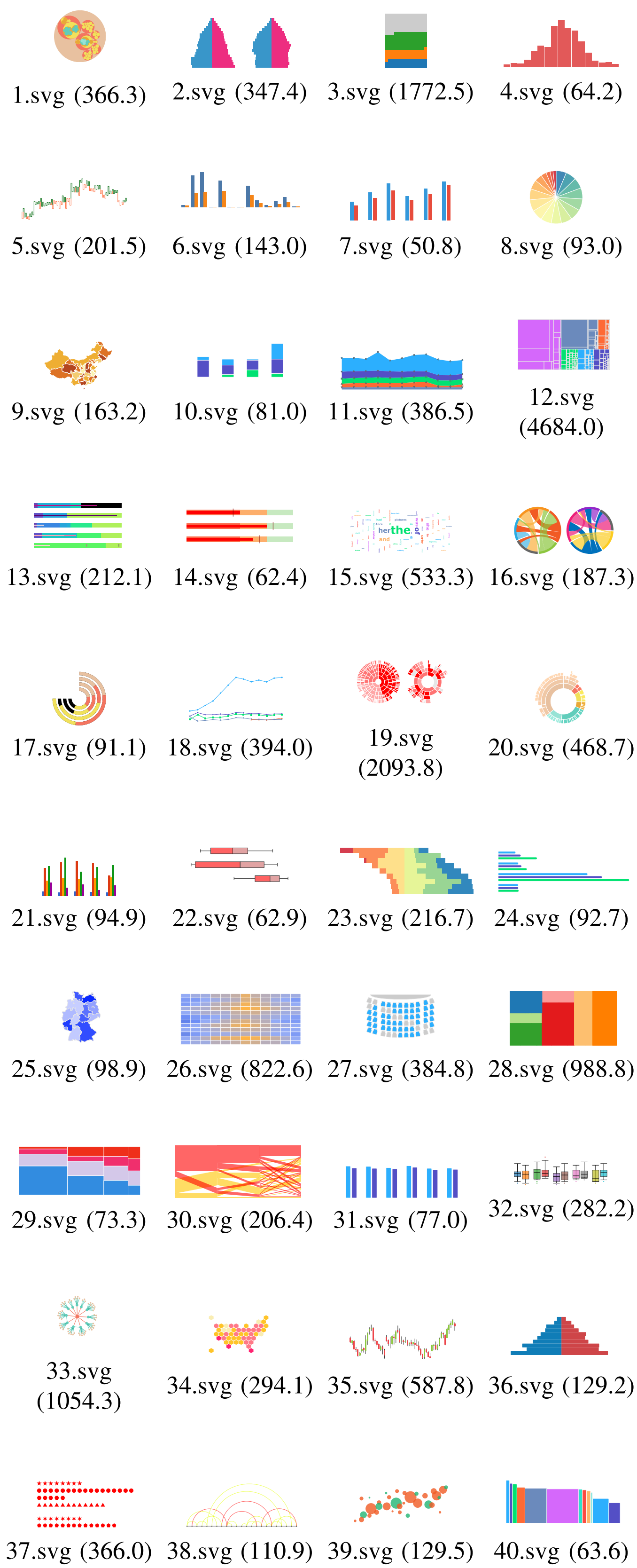
Final Annotation Data Format

The following is an example of the final annotation data format in JSON, which describes the final data structure for training and testing.

```
{
    "all_features": [
      [
        feature_1,
        feature_2,
        feature_3,
        feature_4,
        feature_5,
        feature_6,
        feature_7,
        ... (other features)
        feature_23,
      ],
      // ... (other features of other elements data)
    ],
    "groups": [
    [
      [
        feature_1,
        feature_2,
        feature_3,
        feature_4,
        feature_5,
        feature_6,
        feature_7,
        ... (other features)
        feature_23,
      ],
      // ... (other features of elements data in the group)
    ]
[
```

Training Set

The following figures present all 40 training set visualizations ordered by filename for comprehensive reference and transparency.



Test Set

The following figures present all 20 test set visualizations ordered by filename for comprehensive reference and transparency.