A Multi-task Comparative Study on Scatter Plots and Parallel Coordinates Plots

Reading group Statistics Communication and (in)numeracy

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Article

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Why
Looking for research on viz that aid in interpreting clusterings
Set-up

- Empirical study
- \( n = 42 \): 27 university students, 15 university staff, diverse disciplines
- Compare user performance (accuracy and response time) in 4 different visualization tasks:
  - value retrieval
  - clustering
  - outlier detection
  - and change detection
- 3 forms of stimuli:
  - data tables (DT)
  - scatter plots (SP)
  - parallel coordinate plots (PCP)
- (72) Stimuli data sets contained 8 rows/subjects, 4 columns/variables
Example stimuli for a value retrieval task

Data Table

<table>
<thead>
<tr>
<th>B</th>
<th>G</th>
<th>I</th>
<th>J</th>
<th>ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>87</td>
<td>56</td>
<td>67</td>
<td>32</td>
<td>2</td>
</tr>
<tr>
<td>51</td>
<td>97</td>
<td>21</td>
<td>80</td>
<td>5</td>
</tr>
<tr>
<td>57</td>
<td>10</td>
<td>41</td>
<td>80</td>
<td>4</td>
</tr>
<tr>
<td>97</td>
<td>62</td>
<td>76</td>
<td>61</td>
<td>5</td>
</tr>
<tr>
<td>33</td>
<td>82</td>
<td>81</td>
<td>72</td>
<td>6</td>
</tr>
<tr>
<td>76</td>
<td>72</td>
<td>27</td>
<td>56</td>
<td>8</td>
</tr>
</tbody>
</table>

Values: When B equals to 37, what is the value of I?

- 41
- 67
- 27
- 76

Parallel Coordinates Plot

Values: When O equals to 38, what is the value of U?

- 42
- 68
- 28
- 77

Scatter Plot

Values: When L equals to 39, what is the value of T?

- 43
- 69
- 29
- 78

Some remarks

- Answer alternatives: 1 correct, 3 distractors (easy/medium/hard)
- Unfortunately no examples for other tasks
- Reference to location of these examples (master thesis of first author) is dead
Results

Table 1: The ANOVA results to accompany Figure 4(a,b).

<table>
<thead>
<tr>
<th>Vis. Task</th>
<th>Main Effect</th>
<th>DT v SP</th>
<th>DT v PCP</th>
<th>SP v PCP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value Retr. (Ac)</td>
<td>.037</td>
<td>.037</td>
<td>.153</td>
<td>=1</td>
</tr>
<tr>
<td>Value Retr. (RT)</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Clustering (Ac)</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Clustering (RT)</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
<td>=1</td>
</tr>
<tr>
<td>Outlier Det. (Ac)</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
<td>=.018</td>
</tr>
<tr>
<td>Outlier Det. (RT)</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
<td>=.002</td>
</tr>
<tr>
<td>Change Det. (Ac)</td>
<td>&lt;.001</td>
<td>.423</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Change Det. (RT)</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

Conclusion of experiment

- DT are better for value retrieval task
- PCP outperform DT and SP in the other tasks
- Subjective user-feedbacks consistent with quantitative analyses
The good and the not so good

+

- A study on the difference SP/PCP for clustering
- Nice method of assembling data sets for the tasks
- Lots of attention to the experimental set-up

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- Very small sample size
- Not a complete impression of stimuli available
- Very small clustering task (8 subjects, 4 var)
- No mention regarding repeated measures
- Dead link for anova results
- So no possibility to check statistical approach

So, sorry.