

## **Supplemental Material: ID 1150**

### **Exploring the Visualization Design Space with Repertory Grids**

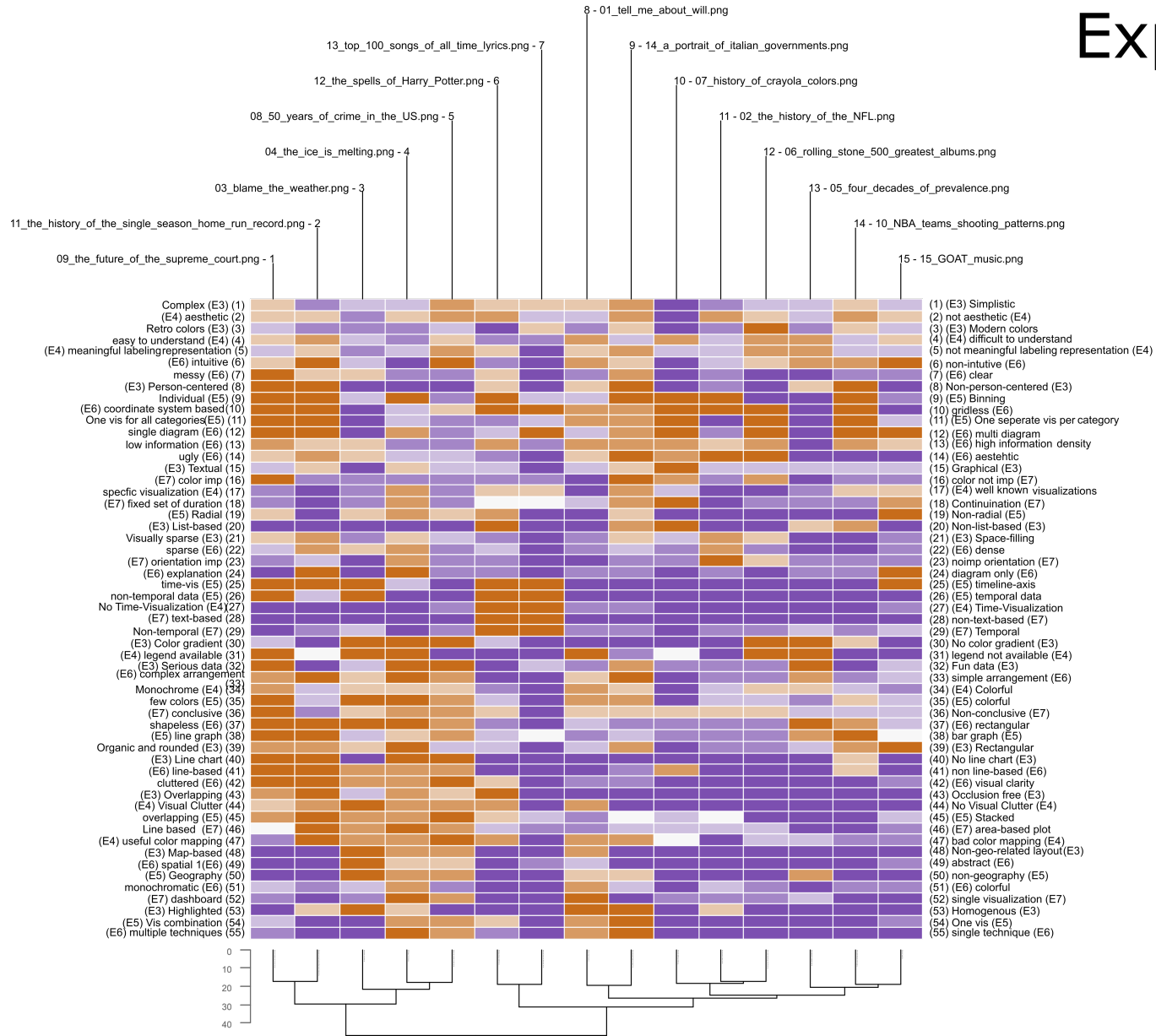
This supplemental material contains a detailed listing of all the results summarized in the paper:

1. Summary of construct categories
2. Meta Grids
3. Frequency of element use
4. Questionnaire
5. Descriptive statistics
6. Matrices
7. Complete list of constructs

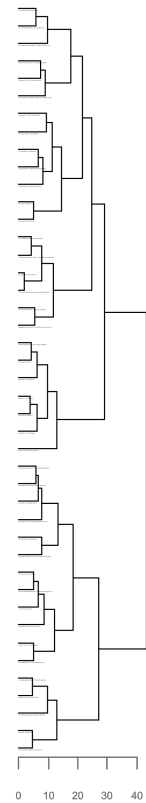
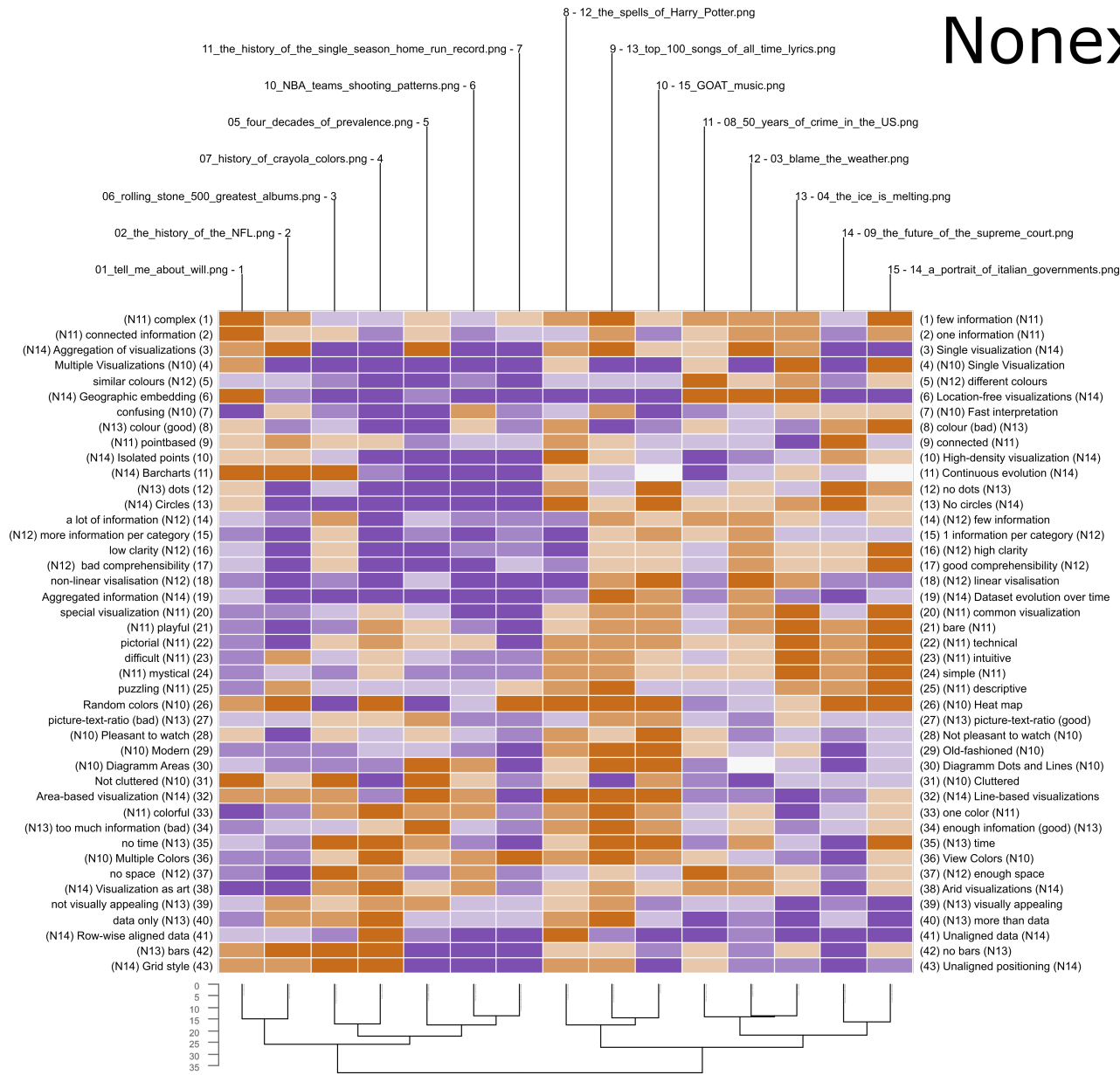
Table : Constructs according the identified categories with descriptions, the frequency of constructs, and the ratio between experts (E) and nonexperts (N) of applied constructs.

Constructs	Description	Frequency	E : N
<b>Visual Mapping</b>			
<b>Visual primitives</b> ( <i>line-based – area-based, circles – no circles, organic and rounded – rectangular, ...</i> )	The depiction of visual primitives such as lines, dots, rectangles is described.	12	6:6
<b>Color mapping</b> ( <i>no color gradient – color gradient, few colors – multiple colors, random colors – heat map, ...</i> )	Constructs refer to the color mapping, describing the number of used colors, but also judging the applied color map.	11	6:5
<b>Text</b> ( <i>graphical – textual, legend – no legend, meaningful labeling – not meaningful representation, ...</i> )	Constructs describe the use of text either as description, legend, or labels.	5	4:1
<b>Aggregation</b> ( <i>individual – binning, connected – point-based, aggregated information – dataset evolution over time</i> )	Constructs that differentiate visualizations showing the data either by individual data points or aggregated.	3	1:2
<b>Composition</b>			
<b>Multi-visualization</b> ( <i>single technique – multiple techniques, single diagram – multi diagram, single visualization – dashboard, ...</i> )	Describes the visualization considering the use of small multiples and multiple views.	8	6:2
<b>Alignment</b> ( <i>unaligned positioning – grid style, no important orientation – orientation important, nonradial – radial, ...</i> )	Considers the alignment of visualization components for example on axis, a grid, or radial.	8	5:3
<b>Visual clutter</b> ( <i>occlusion free – overlapping, no visual clutter – visual clutter, messy – clear, ...</i> )	Constructs consider how much occlusion and “mess” is visible in the visualizations.	6	5:1
<b>Visual density</b> ( <i>sparse – dense, visually sparse – space-filling, no space – enough space, ...</i> )	Constructs that describe visualizations depending on how much white space is visible.	4	2:2
<b>Geo-spatial layout</b> ( <i>non-geo-related layout – map-based, abstract – spatial 1:1 mapping, location-free visualizations – geographic embedding</i> )	Describes if the geo-spatial context of the data is also depicted in the visualization.	3	2:1
<b>Visual complexity</b> ( <i>simple arrangement – complex arrangement, complex – simplistic</i> )	Describes the complexity of a visualization considering the visual elements and their arrangement.	2	2:0
<b>Data-Related</b>			
<b>Temporal data</b> ( <i>nontemporal data – temporal data, no time-visualization – time-visualization, continuation – fixed set of duration, ...</i> )	Constructs describe to which degree temporal data was visualized.	5	4:1
<b>Informative content</b> ( <i>few information – complex, one information per category – more information per category, low information density – high information density, ...</i> )	Considers how much information from the data is represented by the visualization.	5	1:4
<b>Specific data</b> ( <i>nongeographic – geographic, non-person-centered – person-centered, fun data – serious data, ...</i> )	Considers if data is about a specific topic such as countries, people, or text and if the data is serious.	4	4:0
<b>Visual Experience</b>			
<b>Comprehension</b> ( <i>easy to understand – difficult to understand, nonintuitive – intuitive, confusing – fast interpretation, ...</i> )	Constructs describe how well a visualization could be interpreted.	9	3:6
<b>Visual appeal</b> ( <i>not aesthetic – aesthetic, not pleasant to watch – pleasant to watch, bare – playful</i> )	Describes how visually appealing a visualization is considering aesthetics and the arousal of interest.	7	2:5
<b>Modernity</b> ( <i>retro colors – modern colors, old-fashioned – modern</i> )	Describes how modern a visualization is perceived.	2	1:1
<b>Familiarity</b> ( <i>specific visualization – well known visualizations, special visualization – common visualization</i> )	Describes how familiar the visualization is, or if one has to learn interpreting it.	2	1:1
<b>Perceived precision</b> ( <i>pictorial – technical, data only – more than data</i> )	Constructs describe if a visualization seems more technical or not, and if more than just the data is communicated.	2	0:2

# Experts

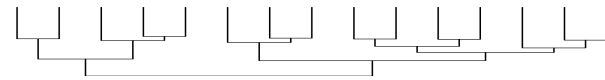
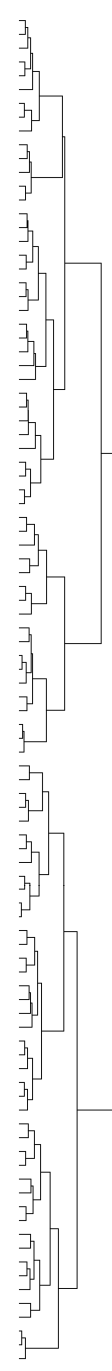
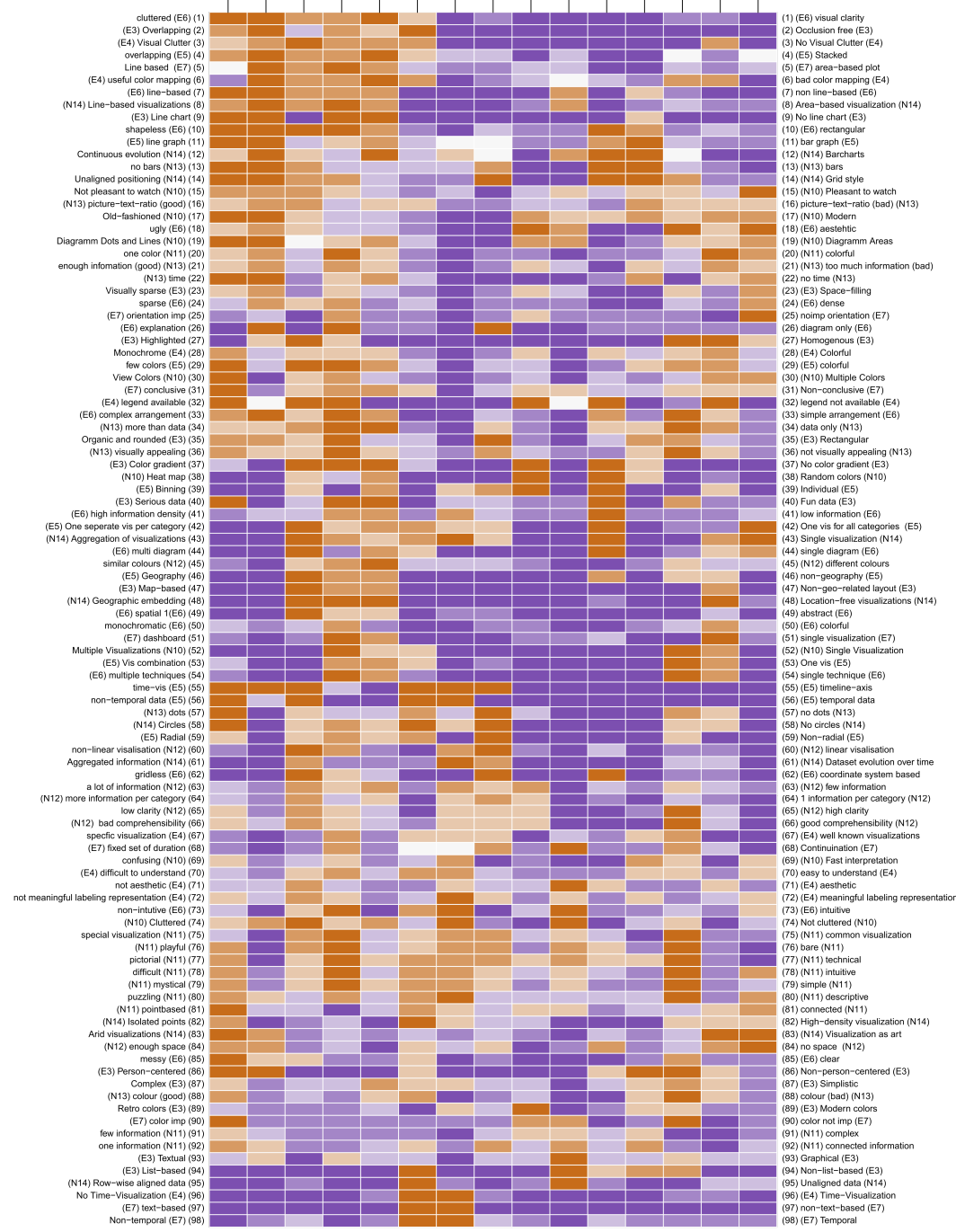


# Nonexperts



All

13\_top\_100\_songs\_of\_all\_time\_lyrics.png - 7  
 12\_the\_spells\_of\_Harry\_Potter.png - 6  
 08\_50\_years\_of\_crime\_in\_the\_US.png - 5  
 04\_the\_ice\_is\_melting.png - 4  
 03\_blame\_the\_weather.png - 3  
 11\_the\_history\_of\_the\_single\_season\_home\_run\_record.png - 2  
 09\_the\_future\_of\_the\_supreme\_court.png - 1  
 8 - 15\_GOAT\_music.png  
 9 - 06\_rolling\_stone\_500\_greatest\_albums.png  
 10 - 07\_history\_of\_crayola\_colors.png  
 11 - 05\_four\_decades\_of\_prevalence.png  
 12 - 10\_NBA\_teams\_shooting\_patterns.png  
 13 - 14\_a\_portrait\_of\_italian\_governments.png  
 14 - 01\_tell\_me\_about\_will.png  
 15 - 02\_the\_history\_of\_the\_NFL.png



### 3. Frequency of Element Use

	Visualization 1	Visualization 2	Visualization 3	Visualization 4	Visualization 5	Visualization 6	Visualization 7	Visualization 8	Visualization 9	Visualization 10	Visualization 11	Visualization 12	Visualization 13	Visualization 14	Visualization 15
	2	2	2	2	1	2	7	3	2	3	3	3	2	3	2
	1	1	1	2	1	2	2	2	3	1	2	2	3	2	2
	1	2	3	1	2	1	3	3	2	3	2	1	2	2	2
	2	2	2	4	5	3	4	2	3	1	5	2	5	1	4
	1	2	1	2	1	2	1	2	3	1	1	1	3	2	1
	2	1	1	1	3	1	1	2	1	1	2	1	3	1	3
	2	2	1	4	1	1	1	1	1	4	4	1	3	2	2
	1	3	1	1	2	1	3	1	1	1	1	1	1	2	1
	1	3	2	1	1	1	2	2	1	1	1	1	2	4	1
	1	1	1	1	2	1	1	1	4	4	3	2	5	1	2
<b>MEAN</b>	1.4	1.9	1.5	1.9	1.9	1.5	2.5	1.9	2.1	2	2.4	1.5	2.9	2	2
<b>SD</b>	0.516398	0.737865	0.707107	1.197219	1.286684	0.707107	1.900292	0.737865	1.100505	1.333333	1.349897	0.707107	1.286684	0.942809	0.942809

## 4. Questionnaire

How well did you understand the visualization?

	Visualization 1	Visualization 2	Visualization 3	Visualization 4	Visualization 5	Visualization 6	Visualization 7	Visualization 8	Visualization 9	Visualization 10	Visualization 11	Visualization 12	Visualization 13	Visualization 14	Visualization 15	
	5	3	2	5	5	3	5	5	3	3	5	5	3	4	2	
	7	7	7	5	7	7	7	7	7	4	7	5	3	4	7	
	5	6	5	5	7	6	7	7	5	6	7	7	6	5	6	
	7	4	4	3	7	5	3	7	5	6	7	4	2	7	7	
	6	7	6	7	5	7	7	7	7	3	2	6	6	6	6	
	7	3	4	3	7	6	7	5	6	3	7	7	1	2	7	
	7	1	1	3	7	7	5	5	2	6	7	3	2	1	6	
	6	7	3	2	7	3	7	5	5	7	6	6	4	4	4	
	5	6	2	5	5	6	5	3	6	5	7	6	1	7	2	
	5	6	7	3	7	2	6	5	7	6	6	5	6	1	4	
<b>MEAN</b>	<b>Group</b>	6	5	4.1	4.1	6.4	5.2	5.9	5.6	5.3	4.9	6.1	5.4	3.4	4.1	5.1
	<b>Expert</b>	6	5.4	4.8	5	6.2	5.6	5.8	6.6	5.4	4.4	5.6	5.4	4	5.2	5.6
	<b>Nonexpert</b>	6	4.6	3.4	3.2	6.6	4.8	6	4.6	5.2	5.4	6.6	5.4	2.8	3	4.6
<b>SD</b>	<b>Group</b>	0.943	2.108	2.132	1.524	0.966	1.874	1.370	1.350	1.703	1.524	1.595	1.265	2.011	2.234	1.969
	<b>Expert</b>	1.000	1.817	1.924	1.414	1.095	1.673	1.789	0.894	1.673	1.517	2.191	1.140	1.871	1.304	2.074
	<b>NonExpert</b>	1.000	2.510	2.302	1.095	0.894	2.168	1.000	0.894	1.924	1.517	0.548	1.517	2.168	2.550	1.949

## 5. Descriptive Statistics

### Grid Statistics (Expert)

		vars	n	mean	sd	median	trimmed	mad	min	max	range	skew	kurtosis	se
P3	(1) No line ch - Line chart	1	15	2.867	2.774	1.000	2.692	0.000	1	7	6	0.709	-1.526	0.716
	(2) Visually s - Space-fill	2	15	4.733	1.870	5.000	4.769	2.965	2	7	5	-0.189	-1.705	0.483
	(3) Non-geo-re - Map-based	3	15	2.400	2.414	1.000	2.154	0.000	1	7	6	0.981	-1.050	0.623
	(4) Non-person - Person-cen	4	15	3.467	2.696	2.000	3.385	1.483	1	7	6	0.269	-1.859	0.696
	(5) Organic an - Rectangula	5	15	3.933	2.154	5.000	3.923	2.965	1	7	6	0.000	-1.688	0.556
	(6) No color g - Color grad	6	15	3.533	2.774	3.000	3.462	2.965	1	7	6	0.304	-1.857	0.716
	(7) Non-list-b - List-based	7	15	2.733	2.576	1.000	2.538	0.000	1	7	6	0.720	-1.476	0.665
	(8) Occlusion - Overlappin	8	15	2.867	2.532	1.000	2.692	0.000	1	7	6	0.632	-1.529	0.654
	(9) Retro colo - Modern col	9	15	5.000	1.732	6.000	5.154	1.483	1	7	6	-0.847	-0.467	0.447
	(10) Fun data - Serious da	10	15	3.600	2.444	3.000	3.538	2.965	1	7	6	0.463	-1.633	0.631
	(11) Complex - Simplistic	11	15	4.200	1.568	5.000	4.154	2.965	2	7	5	0.108	-1.435	0.405
	(12) Homogenous - Highlighte	12	15	3.000	2.619	1.000	2.846	0.000	1	7	6	0.535	-1.639	0.676
	(13) Graphical - Textual	13	15	3.400	1.549	3.000	3.308	0.000	1	7	6	0.551	-0.058	0.400
P4	(1) No Time-Vi - Time-Visua	1	15	5.933	2.052	7.000	6.231	0.000	1	7	6	-1.769	1.501	0.530
	(2) Monochrome - Colorful	2	15	4.200	1.740	3.000	4.154	1.483	2	7	5	0.322	-1.514	0.449
	(3) No Visual - Visual Clu	3	15	3.333	2.610	1.000	3.231	0.000	1	7	6	0.177	-2.025	0.674
	(4) specific vi - well known	4	15	4.867	1.959	6.000	4.923	1.483	2	7	5	-0.252	-1.764	0.506
	(5) not aesthe - aesthetic	5	15	4.467	1.642	5.000	4.615	1.483	1	6	5	-0.713	-0.950	0.424
	(6) not meanin - meaningful	6	15	4.000	1.648	3.000	4.077	2.965	1	6	5	-0.089	-1.462	0.425
	(7) bad color - useful col	7	15	4.133	2.232	4.000	4.154	2.965	1	7	6	-0.084	-1.780	0.576
	(8) legend not - legend ava	8	15	3.867	2.825	4.000	3.846	4.448	1	7	6	0.109	-1.958	0.729
	(9) easy to un - difficult	9	15	3.800	1.656	3.000	3.769	1.483	2	6	4	0.120	-1.828	0.428
P5	(1) few colors - colorful	1	15	3.800	2.178	5.000	3.769	2.965	1	7	6	0.006	-1.637	0.562
	(2) time-vis - timeline-a	2	15	4.467	2.973	7.000	4.538	0.000	1	7	6	-0.304	-1.979	0.768
	(3) non-tempor - temporal d	3	15	5.267	2.712	7.000	5.462	0.000	1	7	6	-0.865	-1.254	0.700
	(4) bar graph - line graph	4	15	4.200	1.971	4.000	4.154	2.965	2	7	5	0.263	-1.650	0.509
	(5) Non-radial - Radial	5	15	3.133	2.416	1.000	3.000	0.000	1	7	6	0.252	-1.879	0.624
	(6) Individual - Binning	6	15	3.267	2.576	1.000	3.154	0.000	1	7	6	0.263	-1.883	0.665
	(7) non-geogra - Geography	7	15	2.933	2.492	1.000	2.769	0.000	1	7	6	0.458	-1.788	0.643
	(8) overlappin - Stacked	8	15	4.067	2.154	4.000	4.077	2.965	1	7	6	0.000	-1.540	0.556
	(9) One vis - Vis combin	9	15	2.867	2.386	1.000	2.692	0.000	1	7	6	0.588	-1.562	0.616
	(10) One vis fo - One sepera	10	15	3.800	2.541	5.000	3.769	2.965	1	7	6	0.014	-1.887	0.656
P6	(1) monochroma - colorful	1	15	5.467	1.598	6.000	5.615	1.483	2	7	5	-1.121	0.188	0.413
	(2) sparse - dense	2	15	5.000	1.852	6.000	5.077	1.483	2	7	5	-0.630	-1.231	0.478
	(3) shapeless - rectangula	3	15	3.733	2.434	5.000	3.692	2.965	1	7	6	-0.071	-1.959	0.628



(4) non line-b - line-based	4	15	3.467	2.642	2.000	3.385	1.483	1	7	6	0.176	-1.980	0.682
(5) single tec - multiple t	5	15	2.600	2.473	1.000	2.385	0.000	1	7	6	0.933	-1.081	0.638
(6) single dia - multi diag	6	15	3.133	2.503	2.000	3.000	1.483	1	7	6	0.446	-1.719	0.646
(7) diagram on - explanatio	7	15	2.667	2.289	2.000	2.462	1.483	1	7	6	1.217	-0.333	0.591
(8) simple arr - complex ar	8	15	4.067	2.404	5.000	4.077	2.965	1	7	6	-0.073	-1.829	0.621
(9) gridless - coordinate	9	15	5.267	2.463	7.000	5.462	0.000	1	7	6	-0.902	-1.019	0.636
(10) abstract - spatial 1	10	15	2.200	1.935	1.000	1.923	0.000	1	7	6	1.284	0.202	0.500
(11) cluttered - visual cla	11	15	4.667	2.610	6.000	4.769	1.483	1	7	6	-0.402	-1.795	0.674
(12) low inform - high infor	12	15	3.400	1.844	3.000	3.231	1.483	2	7	5	0.850	-1.085	0.476
(13) ugly - aestehitic	13	15	4.000	2.390	3.000	4.000	2.965	1	7	6	0.088	-1.734	0.617
(14) messy - clear	14	15	5.067	2.052	6.000	5.231	1.483	1	7	6	-0.685	-1.205	0.530
(15) non-intuti - intuitive	15	15	4.333	2.289	5.000	4.385	2.965	1	7	6	-0.316	-1.586	0.591

P7	(1) Non-tempor - Temporal	1	15	5.333	1.877	6.000	5.538	1.483	1	7	6	-1.480	0.918	0.485
	(2) non-text-b - text-based	2	15	1.800	2.111	1.000	1.462	0.000	1	7	6	1.945	1.925	0.545
	(3) Continua - fixed set	3	15	3.333	2.024	2.000	3.231	1.483	1	7	6	0.540	-1.366	0.523
	(4) Non-conclu - conclusive	4	15	4.400	1.639	5.000	4.462	1.483	1	7	6	-0.516	-0.800	0.423
	(5) noimp orie - orientatio	5	15	2.667	1.839	2.000	2.462	0.000	1	7	6	1.232	0.094	0.475
	(6) Line based - area-based	6	15	4.467	2.031	5.000	4.538	1.483	1	7	6	-0.552	-1.188	0.524
	(7) single vis - dashboard	7	15	2.600	2.197	2.000	2.385	1.483	1	7	6	1.157	-0.360	0.567
	(8) color not - color imp	8	15	3.067	2.187	2.000	2.923	0.000	1	7	6	0.916	-1.032	0.565

<b>MEAN</b>			3.798	2.221	3.527	3.758	1.402	1.2	6.95	5.7818	0.123	-1.213	0.573
<b>SD</b>			0.923	0.379	2.017	1.057	1.257	0.4	0.23	0.4591	0.713	0.871	0.098

## Grid Statistics (Nonexpert)

		vars	n	mean	sd	median	trimmed	mad	min	max	range	skew	kurtosis	se
P10	(1) Diagramm D - Diagramm A	1	15	3.667	2.193	3.000	3.615	1.483	1	7	6	0.435	-1.456	0.566
	(2) View Color - Multiple C	2	15	4.600	2.063	5.000	4.692	2.965	1	7	6	-0.406	-1.445	0.533
	(3) Random col - Heat map	3	15	2.867	2.416	1.000	2.692	0.000	1	7	6	0.656	-1.398	0.624
	(4) Not pleasa - Pleasant t	4	15	3.800	1.740	3.000	3.769	2.965	1	7	6	0.134	-1.305	0.449
	(5) confusing - Fast inter	5	15	4.800	1.935	5.000	4.846	2.965	2	7	5	-0.179	-1.740	0.500
	(6) Multiple V - Single Vis	6	15	5.333	2.498	7.000	5.538	0.000	1	7	6	-0.765	-1.347	0.645
	(7) Not clutter - Cluttered	7	15	4.133	2.264	5.000	4.154	2.965	1	7	6	-0.119	-1.620	0.584
	(8) Old-fashio - Modern	8	15	3.467	2.031	3.000	3.385	1.483	1	7	6	0.547	-1.210	0.524
P11	(1) one color - colorful	1	15	4.400	2.165	5.000	4.462	2.965	1	7	6	-0.366	-1.586	0.559
	(2) connected - pointbased	2	15	4.000	1.690	3.000	4.000	2.965	1	7	6	0.083	-1.203	0.436
	(3) simple - mystical	3	15	4.333	1.952	5.000	4.308	2.965	2	7	5	-0.116	-1.730	0.504
	(4) few inform - complex	4	15	5.200	1.521	6.000	5.231	1.483	3	7	4	-0.427	-1.416	0.393
	(5) pictorial - technical	5	15	3.133	1.959	3.000	3.000	1.483	1	7	6	0.997	-0.446	0.506
	(6) bare - playful	6	15	4.333	2.225	5.000	4.385	2.965	1	7	6	-0.320	-1.698	0.575
	(7) one inform - connected	7	15	4.333	1.799	5.000	4.308	1.483	2	7	5	-0.193	-1.683	0.465

	(8) special vi - common vis	8	15	4.000	2.104	5.000	4.000	2.965	1	7	6	-0.043	-1.606	0.543
	(9) difficult - intuitive	9	15	3.467	1.846	3.000	3.462	2.965	1	6	5	0.176	-1.665	0.477
	(10) puzzling - descriptiv	10	15	3.600	1.765	5.000	3.615	1.483	1	6	5	-0.227	-1.778	0.456
P12	(1) non-linear - linear vis	1	15	5.067	2.314	6.000	5.231	1.483	1	7	6	-0.818	-1.144	0.597
	(2) a lot of i - few inform	2	15	4.200	1.821	5.000	4.154	2.965	2	7	5	-0.011	-1.758	0.470
	(3) similar co - different	3	15	4.867	1.846	5.000	5.000	1.483	1	7	6	-0.645	-0.807	0.477
	(4) no space - enough spa	4	15	3.867	2.066	3.000	3.846	2.965	1	7	6	0.030	-1.697	0.533
	(5) 1 informat - more infor	5	15	3.067	1.870	3.000	3.000	2.965	1	6	5	0.339	-1.544	0.483
	(6) good compr - bad compre	6	15	3.533	2.031	3.000	3.462	2.965	1	7	6	0.027	-1.529	0.524
	(7) low clarit - high clari	7	15	4.533	2.066	5.000	4.615	2.965	1	7	6	-0.090	-1.601	0.533
P13	(1) no time - time	1	15	3.600	2.444	3.000	3.538	2.965	1	7	6	0.134	-1.848	0.631
	(2) no dots - dots	2	15	3.533	2.295	3.000	3.462	2.965	1	7	6	0.208	-1.610	0.593
	(3) no bars - bars	3	15	4.000	2.390	5.000	4.000	2.965	1	7	6	-0.146	-1.734	0.617
	(4) not visual - visually a	4	15	4.333	1.839	5.000	4.308	2.965	2	7	5	-0.074	-1.586	0.475
	(5) picture-te - picture-te	5	15	4.200	1.521	5.000	4.231	1.483	2	6	4	-0.314	-1.625	0.393
	(6) enough inf - too much i	6	15	4.133	1.807	3.000	4.077	1.483	2	7	5	0.290	-1.554	0.467
	(7) colour (ba - colour (go	7	15	3.400	2.063	3.000	3.308	2.965	1	7	6	0.315	-1.551	0.533
	(8) data only - more than	8	15	4.400	2.197	5.000	4.462	2.965	1	7	6	-0.365	-1.520	0.567
P14	(1) No circles - Circles	1	15	3.867	2.532	5.000	3.846	2.965	1	7	6	-0.132	-1.826	0.654
	(2) Aggregated - Dataset ev	2	15	5.467	2.100	6.000	5.692	1.483	1	7	6	-1.058	-0.511	0.542
	(3) Location-f - Geographic	3	15	2.733	2.685	1.000	2.538	0.000	1	7	6	0.906	-1.195	0.693
	(4) Area-based - Line-based	4	15	3.533	2.446	2.000	3.462	1.483	1	7	6	0.291	-1.837	0.631
	(5) Continuous - Barcharts	5	15	3.600	2.230	3.000	3.538	2.965	1	7	6	0.292	-1.386	0.576
	(6) High-densi - Isolated p	6	15	3.267	2.086	3.000	3.154	2.965	1	7	6	0.242	-1.519	0.539
	(7) Unaligned - Row-wise a	7	15	2.333	2.024	2.000	2.077	1.483	1	7	6	1.505	0.860	0.523
	(8) Arid visua - Visualizat	8	15	4.467	2.100	5.000	4.538	1.483	1	7	6	-0.756	-1.150	0.542
	(9) Unaligned - Grid style	9	15	3.600	2.530	2.000	3.538	1.483	1	7	6	0.150	-1.939	0.653
	(10) Single vis - Aggregatio	10	15	4.133	2.722	5.000	4.154	2.965	1	7	6	-0.230	-1.924	0.703
	<b>MEAN</b>			3.981	2.097	4.023	3.970	2.241	1.209	6.907	5.698	-0.001	-1.439	0.542
	<b>SD</b>			0.688	0.289	1.422	0.777	0.936	0.466	0.294	0.558	0.490	0.484	0.075

## Correlations (Expert)

P3

No line ch - Line chart	1.00	-0.37	0.22	0.26	-0.50	0.27	-0.29	0.69	0.06	0.37	-0.16	-0.08	0.21
Visually s - Space-fill	-0.37	1.00	0.10	-0.10	0.21	0.14	0.31	-0.34	0.04	-0.12	-0.27	-0.35	-0.45
Non-geo-re - Map-based	0.22	0.10	1.00	-0.35	-0.13	0.46	-0.42	0.21	0.27	0.27	-0.15	0.50	-0.20
Non-person - Person-cen	0.26	-0.10	-0.35	1.00	-0.39	-0.25	0.37	0.22	-0.02	-0.01	-0.36	0.14	0.16
Organic an - Rectangula	-0.50	0.21	-0.13	-0.39	1.00	-0.09	0.13	-0.36	0.00	-0.26	0.13	-0.28	-0.12
No color g - Color grad	0.27	0.14	0.46	-0.25	-0.09	1.00	-0.10	0.17	-0.15	0.41	-0.06	-0.16	-0.25
Non-list-b - List-based	-0.29	0.31	-0.42	0.37	0.13	-0.10	1.00	-0.14	0.13	-0.14	-0.07	-0.23	0.42
Occlusion - Overlappin	0.69	-0.34	0.21	0.22	-0.36	0.17	-0.14	1.00	0.41	0.18	-0.10	0.00	0.12
Retro colo - Modern col	0.06	0.04	0.27	-0.02	0.00	-0.15	0.13	0.41	1.00	0.00	0.37	0.19	0.27
Fun data - Serious da	0.37	-0.12	0.27	-0.01	-0.26	0.41	-0.14	0.18	0.00	1.00	-0.31	-0.02	0.05
Complex - Simplistic	-0.16	-0.27	-0.15	-0.36	0.13	-0.06	-0.07	-0.10	0.37	-0.31	1.00	0.03	0.38
Homogenous - Highlighte	-0.08	-0.35	0.50	0.14	-0.28	-0.16	-0.23	0.00	0.19	-0.02	0.03	1.00	0.07
Graphical - Textual	0.21	-0.45	-0.20	0.16	-0.12	-0.25	0.42	0.12	0.27	0.05	0.38	0.07	1.00

P4

No Time-Vi - Time-Visua	1.00	-0.50	-0.04	0.42	-0.05	0.17	0.05	0.48	-0.51
Monochrome - Colorful	-0.50	1.00	-0.41	-0.35	-0.14	-0.45	-0.34	-0.66	0.24
No Visual - Visual Clu	-0.04	-0.41	1.00	0.20	0.01	0.07	0.73	0.34	0.07
specific vi - well known	0.42	-0.35	0.20	1.00	-0.22	0.27	0.04	0.42	-0.67
not aesthe - aesthetic	-0.05	-0.14	0.01	-0.22	1.00	0.34	0.02	-0.46	0.30
not meanin - meaningful	0.17	-0.45	0.07	0.27	0.34	1.00	0.49	0.12	-0.47
bad color - useful col	0.05	-0.34	0.73	0.04	0.02	0.49	1.00	0.20	-0.07
legend not - legend ava	0.48	-0.66	0.34	0.42	-0.46	0.12	0.20	1.00	-0.40
easy to un - difficult	-0.51	0.24	0.07	-0.67	0.30	-0.47	-0.07	-0.40	1.00

P5

few colors - colorful	1.00	-0.02	0.06	-0.22	-0.51	0.15	-0.57	0.44	-0.58	0.04
time-vis - timeline-a	-0.02	1.00	0.80	-0.22	-0.43	0.08	0.26	0.47	0.19	-0.15
non-tempor - temporal d	0.06	0.80	1.00	-0.09	-0.25	0.11	0.15	0.39	0.14	-0.18
bar graph - line graph	-0.22	-0.22	-0.09	1.00	0.08	-0.12	0.02	-0.29	-0.07	-0.12
Non-radial - Radial	-0.51	-0.43	-0.25	0.08	1.00	-0.07	0.27	-0.54	0.54	0.32
Individual - Binning	0.15	0.08	0.11	-0.12	-0.07	1.00	0.33	0.36	-0.16	0.33
non-geogra - Geography	-0.57	0.26	0.15	0.02	0.27	0.33	1.00	-0.21	0.48	0.43
overlappin - Stacked	0.44	0.47	0.39	-0.29	-0.54	0.36	-0.21	1.00	-0.33	-0.19
One vis - Vis combin	-0.58	0.19	0.14	-0.07	0.54	-0.16	0.48	-0.33	1.00	0.02
One vis fo - One sepera	0.04	-0.15	-0.18	-0.12	0.32	0.33	0.43	-0.19	0.02	1.00

P6

monochroma - colorful	1.00	0.43	0.22	-0.12	-0.67	-0.09	-0.29	-0.49	0.13	-0.45	0.23	0.05	0.26	0.10	0.01
sparse - dense	0.43	1.00	0.29	-0.37	-0.12	-0.14	-0.46	-0.37	0.05	-0.30	0.52	0.06	0.48	0.39	0.22
shapeless - rectangular	0.22	0.29	1.00	-0.69	-0.07	-0.19	-0.30	-0.68	0.43	-0.41	0.64	-0.32	-0.18	0.28	-0.34
non line-b - line-based	-0.12	-0.37	-0.69	1.00	0.09	-0.19	0.17	0.42	0.03	0.36	-0.69	-0.01	-0.16	-0.36	0.01
single tec - multiple t	-0.67	-0.12	-0.07	0.09	1.00	0.11	0.16	0.58	-0.04	0.38	-0.28	0.16	-0.13	-0.14	0.05
single dia - multi diag	-0.09	-0.14	-0.19	-0.19	0.11	1.00	-0.28	0.16	-0.41	0.44	-0.12	0.31	0.05	0.03	0.04
diagram on - explanatio	-0.29	-0.46	-0.30	0.17	0.16	-0.28	1.00	0.38	-0.34	0.10	-0.31	0.19	0.18	-0.01	0.23
simple arr - complex ar	-0.49	-0.37	-0.68	0.42	0.58	0.16	0.38	1.00	-0.37	0.35	-0.58	0.28	-0.17	-0.44	0.42
gridless - coordinate	0.13	0.05	0.43	0.03	-0.04	-0.41	-0.34	-0.37	1.00	-0.55	0.10	-0.47	-0.39	-0.12	-0.16
abstract - spatial 1	-0.45	-0.30	-0.41	0.36	0.38	0.44	0.10	0.35	-0.55	1.00	-0.50	0.36	0.09	0.00	-0.13
cluttered - visual cla	0.23	0.52	0.64	-0.69	-0.28	-0.12	-0.31	-0.58	0.10	-0.50	1.00	-0.10	0.06	0.62	-0.10
low inform - high infor	0.05	0.06	-0.32	-0.01	0.16	0.31	0.19	0.28	-0.47	0.36	-0.10	1.00	0.52	0.43	-0.08
ugly - aesthetic	0.26	0.48	-0.18	-0.16	-0.13	0.05	0.18	-0.17	-0.39	0.09	0.06	0.52	1.00	0.31	0.04
messy - clear	0.10	0.39	0.28	-0.36	-0.14	0.03	-0.01	-0.44	-0.12	0.00	0.62	0.43	0.31	1.00	-0.11
non-intuti - intuitive	0.01	0.22	-0.34	0.01	0.05	0.04	0.23	0.42	-0.16	-0.13	-0.10	-0.08	0.04	-0.11	1.00

P7

Non-tempor - Temporal	1.00	-0.94	-0.03	0.49	0.34	-0.29	0.36	0.36
non-text-b - text-based	-0.94	1.00	0.13	-0.35	-0.26	0.21	-0.30	-0.20
Continuina - fixed set	-0.03	0.13	1.00	0.06	-0.12	0.10	0.03	0.29
Non-conclu - conclusive	0.49	-0.35	0.06	1.00	0.26	-0.34	0.46	0.43
noimp orie - orientatio	0.34	-0.26	-0.12	0.26	1.00	-0.26	0.16	0.04
Line based - area-based	-0.29	0.21	0.10	-0.34	-0.26	1.00	-0.32	0.01
single vis - dashboard	0.36	-0.30	0.03	0.46	0.16	-0.32	1.00	-0.31
color not - color imp	0.36	-0.20	0.29	0.43	0.04	0.01	-0.31	1.00

## Correlations (Nonexpert)

P10

Diagramm D - Diagramm A	1.00	0.38	0.14	0.58	-0.05	0.17	-0.26	0.61
View Color - Multiple C	0.38	1.00	-0.03	0.39	0.21	0.26	0.18	0.35
Random col - Heat map	0.14	-0.03	1.00	0.16	0.22	0.11	-0.30	-0.15
Not pleasa - Pleasant t	0.58	0.39	0.16	1.00	0.45	-0.16	-0.45	0.68
confusing - Fast inter	-0.05	0.21	0.22	0.45	1.00	0.07	-0.30	-0.01
Multiple V - Single Vis	0.17	0.26	0.11	-0.16	0.07	1.00	0.03	-0.22
Not clutter - Cluttered	-0.26	0.18	-0.30	-0.45	-0.30	0.03	1.00	0.13
Old-fashio - Modern	0.61	0.35	-0.15	0.68	-0.01	-0.22	0.13	1.00

**P11**

one color - colorful	1.00	0.08	0.08	-0.31	-0.52	0.34	-0.33	-0.30	-0.07	0.10
connected - pointbased	0.08	1.00	0.00	-0.19	0.19	-0.19	-0.23	0.24	-0.16	-0.22
simple - mystical	0.08	0.00	1.00	0.31	-0.72	0.83	0.05	-0.83	-0.86	-0.60
few inform - complex	-0.31	-0.19	0.31	1.00	0.11	0.15	0.73	-0.38	-0.29	-0.34
pictorial - technical	-0.52	0.19	-0.72	0.11	1.00	-0.85	0.11	0.74	0.53	0.20
bare - playful	0.34	-0.19	0.83	0.15	-0.85	1.00	0.02	-0.88	-0.72	-0.33
one inform - connected	-0.33	-0.23	0.05	0.73	0.11	0.02	1.00	-0.25	-0.09	-0.09
special vi - common vis	-0.30	0.24	-0.83	-0.38	0.74	-0.88	-0.25	1.00	0.77	0.37
difficult - intuitive	-0.07	-0.16	-0.86	-0.29	0.53	-0.72	-0.09	0.77	1.00	0.74
puzzling - descriptiv	0.10	-0.22	-0.60	-0.34	0.20	-0.33	-0.09	0.37	0.74	1.00

**P12**

non-linear - linear vis	1.00	0.67	0.39	0.17	-0.74	-0.59	0.60
a lot of i - few inform	0.67	1.00	0.65	0.52	-0.91	-0.77	0.79
similar co - different	0.39	0.65	1.00	0.41	-0.45	-0.47	0.49
no space - enough spa	0.17	0.52	0.41	1.00	-0.42	-0.27	0.35
1 informat - more infor	-0.74	-0.91	-0.45	-0.42	1.00	0.72	-0.73
good compr - bad compre	-0.59	-0.77	-0.47	-0.27	0.72	1.00	-0.98
low clarit - high clari	0.60	0.79	0.49	0.35	-0.73	-0.98	1.00

**P13**

no time - time	1.00	-0.19	-0.27	0.29	0.62	-0.75	0.27	0.34
no dots - dots	-0.19	1.00	-0.10	0.53	0.05	0.17	0.57	0.28
no bars - bars	-0.27	-0.10	1.00	-0.34	-0.20	-0.12	-0.04	-0.42
not visual - visually a	0.29	0.53	-0.34	1.00	0.33	-0.42	0.51	0.83
picture-te - picture-te	0.62	0.05	-0.20	0.33	1.00	-0.53	0.61	0.34
enough inf - too much i	-0.75	0.17	-0.12	-0.42	-0.53	1.00	-0.25	-0.36
colour (ba - colour (go	0.27	0.57	-0.04	0.51	0.61	-0.25	1.00	0.40
data only - more than	0.34	0.28	-0.42	0.83	0.34	-0.36	0.40	1.00

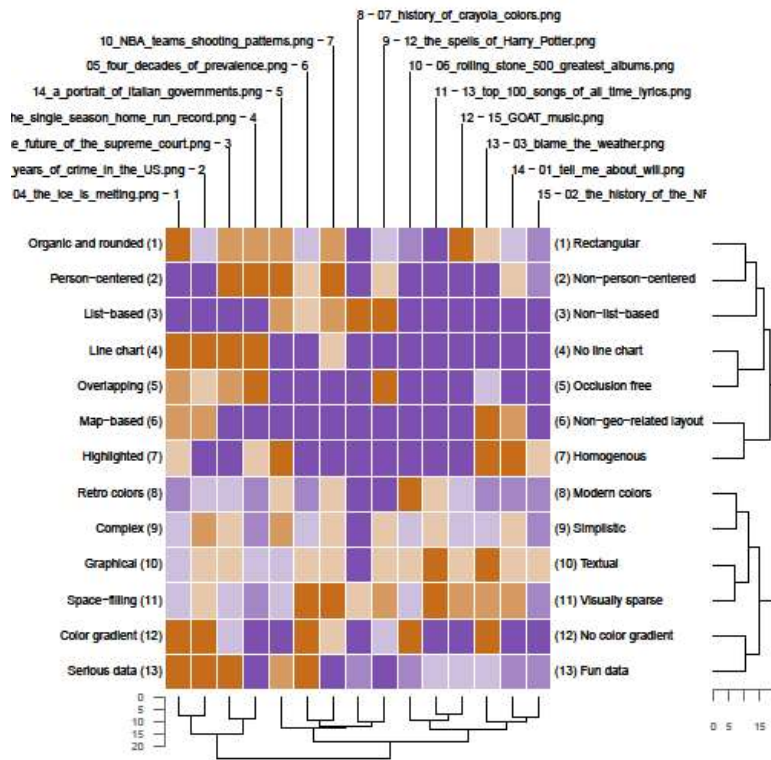
**P14**

No circles - Circles	1.00	-0.52	0.29	0.04	0.18	0.58	-0.07	-0.07	-0.14	0.29
Aggregated - Dataset ev	-0.52	1.00	-0.18	0.23	-0.05	-0.18	0.16	-0.26	0.04	-0.47
Location-f - Geographic	0.29	-0.18	1.00	0.40	0.12	-0.16	-0.18	-0.03	0.04	0.49
Area-based - Line-based	0.04	0.23	0.40	1.00	-0.34	-0.37	-0.15	-0.05	-0.23	-0.30
Continuous - Barcharts	0.18	-0.05	0.12	-0.34	1.00	0.64	0.19	-0.35	0.50	0.23
High-densi - Isolated p	0.58	-0.18	-0.16	-0.37	0.64	1.00	0.23	-0.44	0.28	0.19
Unaligned - Row-wise a	-0.07	0.16	-0.18	-0.15	0.19	0.23	1.00	0.16	0.64	0.10
Arid visua - Visualizat	-0.07	-0.26	-0.03	-0.05	-0.35	-0.44	0.16	1.00	0.12	-0.04
Unaligned - Grid style	-0.14	0.04	0.04	-0.23	0.50	0.28	0.64	0.12	1.00	0.15
Single vis - Aggregatio	0.29	-0.47	0.49	-0.30	0.23	0.19	0.10	-0.04	0.15	1.00

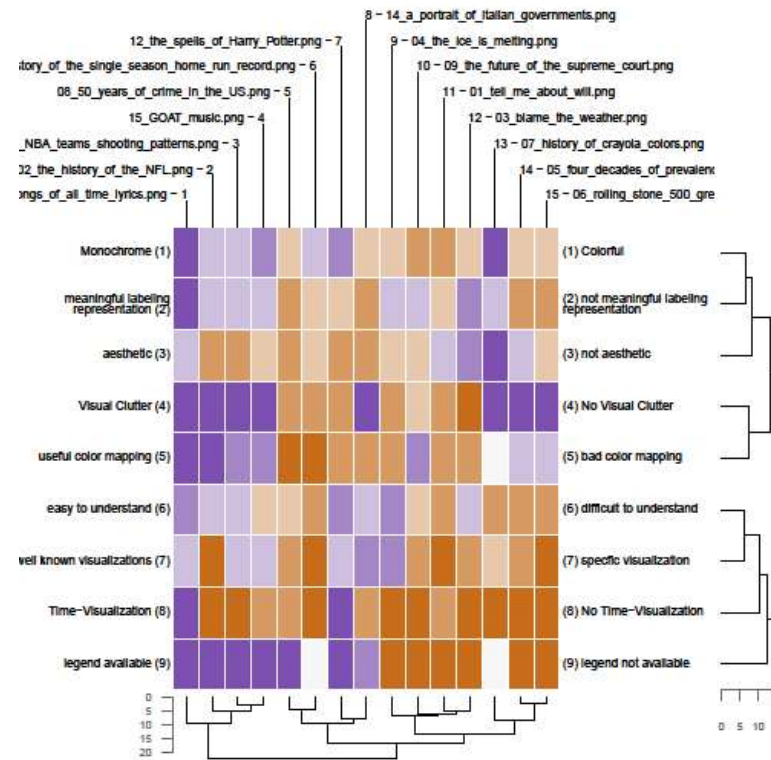
# 6. Matrices

Expert

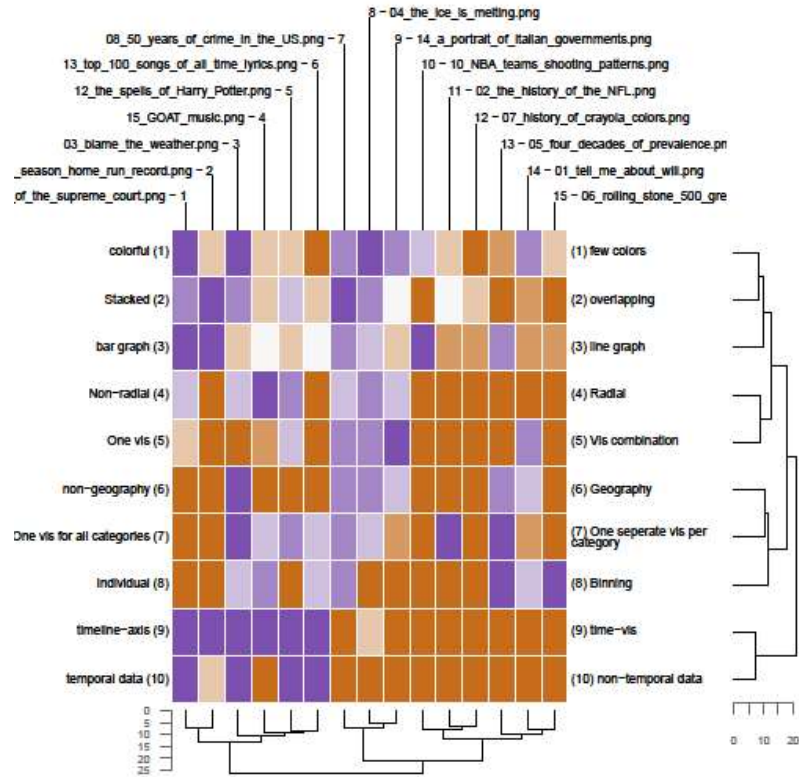
P3



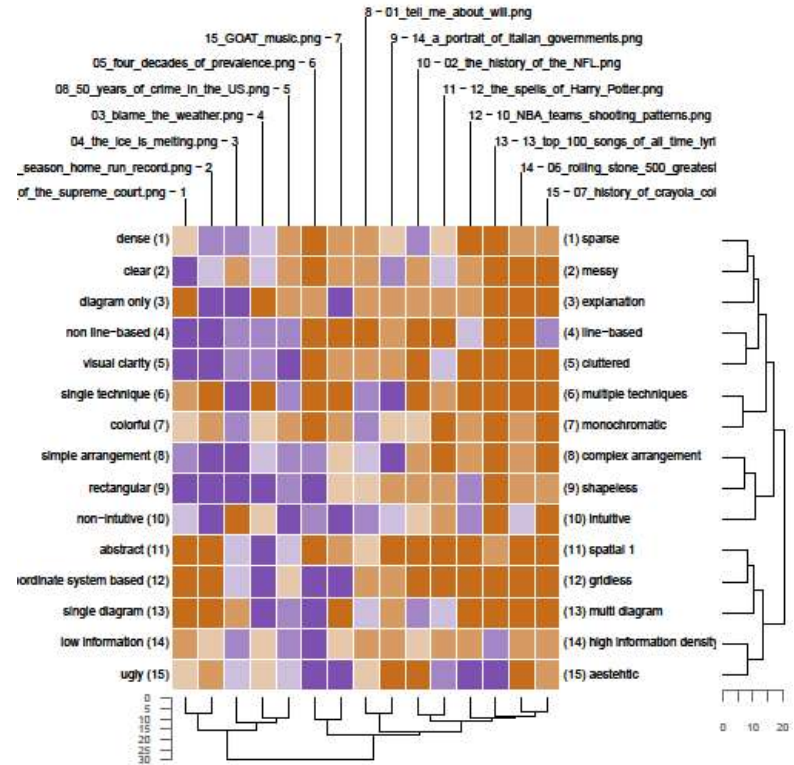
P4



### P5

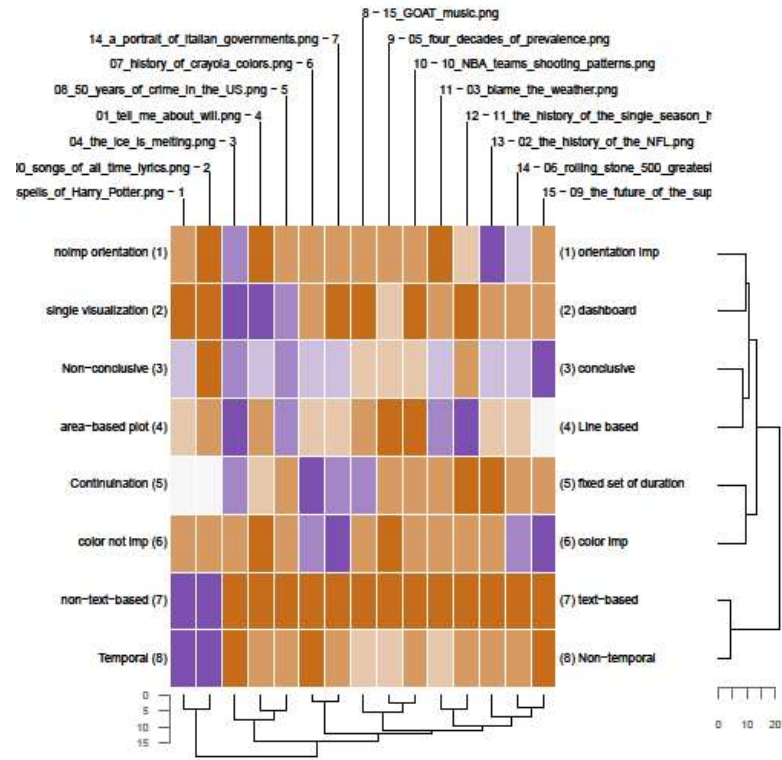


### P6

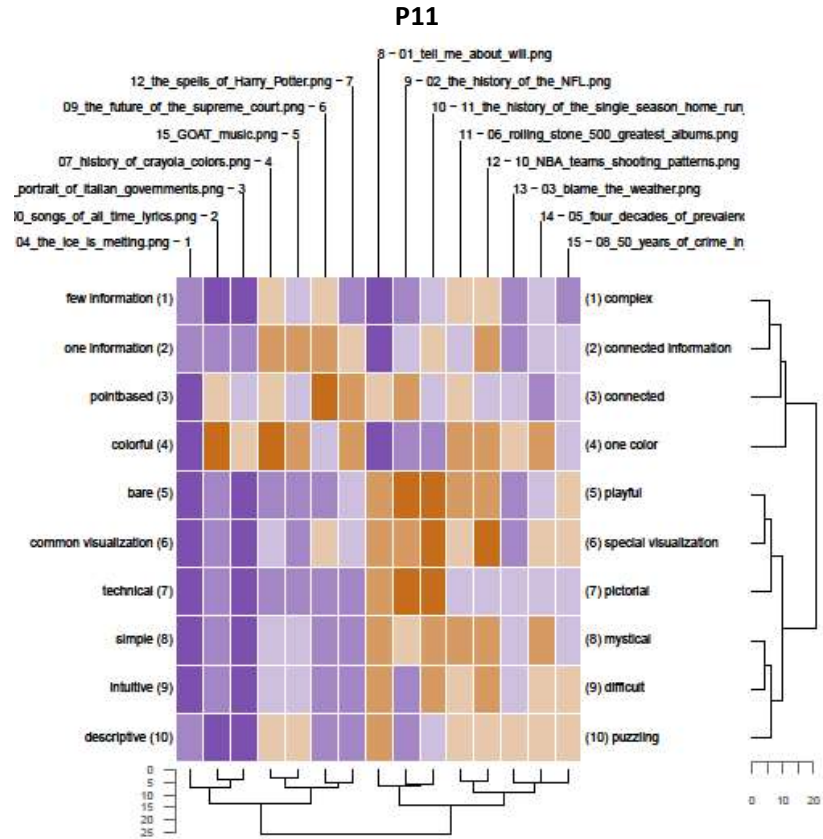
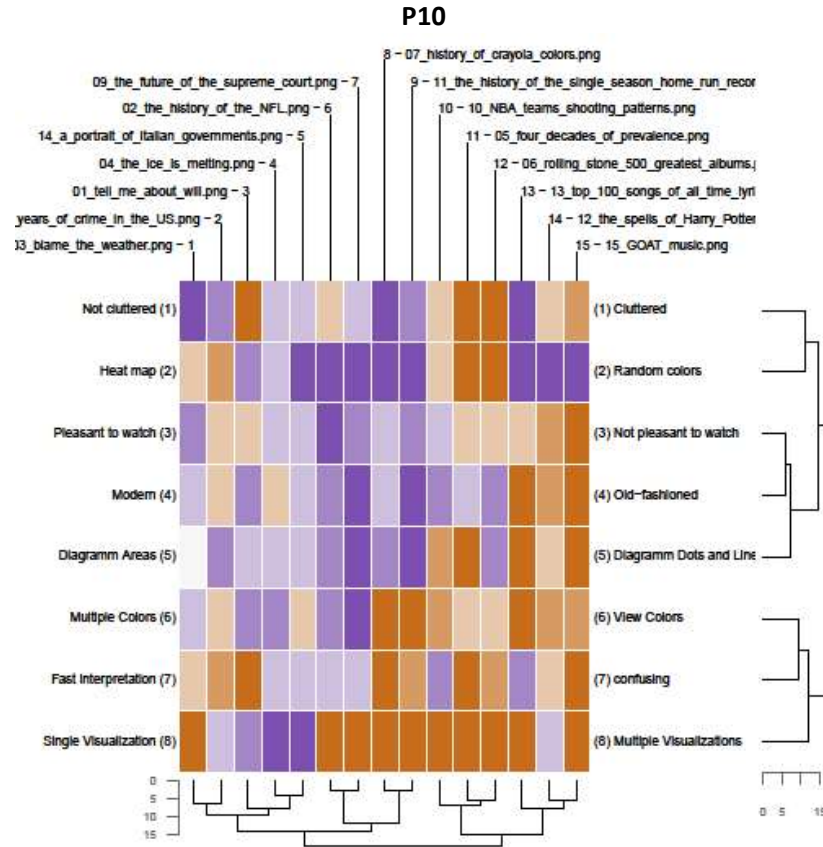




# P7

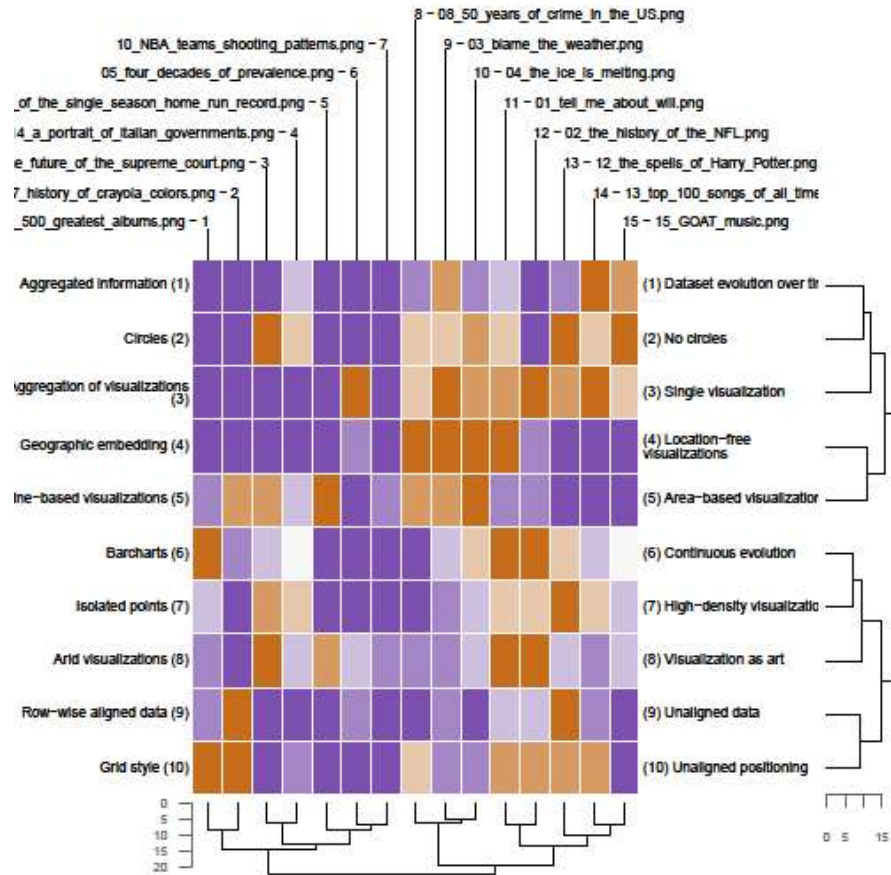


# Nonexpert





P14



## 7. Complete List of Constructs

### Visual Mapping

	Exclusive (1 element)	Inclusive (2 elements)	Description (Exclusive)	Description (Inclusive)
P3	No line chart	Line chart	Does not contain a line chart	Contains a line chart. i.e.. an x-by-y plot with data points connected by a line
P5	bar graph	line graph	data is represented using a bar graph	data is represented using a line graph
P6	non line-based	line-based	lines are not used to convey information	lines are used to present information
P7	Line based	area-based plot	we cannot comment about the density in this case	both have the area under the curve
P10	Diagramm Dots and Lines	Diagramm Areas	Klassisches Diagramm mit Darstellung einzelner Messwerte und Trendlinie	Darstellung der Werte als Flächen
P13	no dots	dots	no visualisation with dots	visualisation with dots
P13	no bars	bars	keine visualisierung mit balken	visualisierung mit balken
P14	Area-based visualization	Line-based visualizations	This visualization uses a broader area for displaying an element of the dataset.	Both visualizations describe datasets by thin lines.
P14	Continuous evolution	Barcharts	This visualization gives the impression of a continuous change in the dataset where the individual sampling points are less important.	These visualizations make use of bar charts following a discrete set of sampling points.
P14	No circles	Circles	This visualization does not aggregate in terms of circles. but spreads information about datasets over the whole area (in x-direction).	Both visualizations make use of circles that stand for individuals or a separated group.
P3	Organic and rounded	Rectangular	Organic (natural) and round shapes dominate the visualization	Rectangular shapes dominate the visualization
P6	shapeless	rectangular	a complex shape represents the information	Rectangular shapes are the primary drawing primitive
P5	Individual	Binning	Representing each data point individually	Using different categories / binning to represent data
P11	connected	pointbased	Datenverläufe. Zusammenhängende Daten	Einzelne Datenpunkte werden dargestellt
P14	Aggregated information	Dataset evolution over time	Instead of showing an evolution. this type of visualization provides a single value per dataset.	In this type of visualizations one can see how the characterizing value of a dataset changes in x-direction (maybe over time).
P3	No color gradient	Color gradient	Color is not used (to encode quantities)	Quantities are encoded in a color gradient

P4	Monochrome	Colorful	not very colorful...	very colorful visualization (the number of different colors)
P4	bad color mapping	useful color mapping	random	according infovis guidelines
P5	few colors	colorful	only few colors (red. blue. gray) are used in the visualization	using many different colors
P6	monochromatic	colorful	Only or mainly a single color is used	Many different colors are used
P7	color not imp	color imp	Even if we change the color hardly matters	Selected color is very important for analysis
P10	View Colors	Multiple Colors	Only two Colors. differences are shown in different intensity of one color	different aspects are shown in different colors
P10	Random colors	Heat map	different random colors are used to represent aspects of data	color gradient shows how a value changes
P11	one color	colorful	Eine Farbe. oder geringe Farbunterschiede	Viele verschiedene Farben
P12	similar colours	different colours	durch Anhäufung ähnlicher Farben nicht auf einen Blick vergleichbar	Durch verschiedene Farben auf einen Blick vergleichbar
P13	colour (bad)	colour (good)	zu viele farben. zu wenige farben. farben sind nicht ansprechend	richtige anzahl an farben. nicht zu viel nicht zu wenig. farben sind ansprechend
P3	Graphical	Textual	There is no or little text in the graphics	Labels and captions consume considerable space in the graphics
P4	legend not available	legend available	no data description	a legend to describe the visualized data
P4	not meaningful labeling representation	meaningful labeling representation	no labels or bad labeling	meaningful labeling
P6	diagram only	explanation	no explanation of the diagram is shown	an explanation of the technique is provided
P13	picture-text-ratio (bad)	picture-text-ratio (good)	Bild und Text	Bild und Text

## Composition

P3	Occlusion free	Overlapping	There are no overlaps of visual elements	Visual elements are overlapping/crossing each other
P4	No Visual Clutter	Visual Clutter	no data items overlap	some data items not visible (overlap)
P5	overlapping	Stacked	data is overlapping	data is stacked on top of each other

P6	cluttered	visual clarity	many overlapping and interfering visual elements	clear visual structure. no overlapping elements
P6	messy	clear	chaotic look	clear visual structures and design
P10	Not cluttered	Cluttered	Easy to read single values	Overlap of values
P3	Homogenous	Highlighted	All elements carry the same visual importance	One element is particularly visually highlighted or focused in the visualization
P5	One vis	Vis combination	only one vis is used to represent the data	a combination is used to represent the data with different visualizations
P5	One vis for all categories	One separate vis per category	One visualization is used to represent individual categories combined	Different categories are used and visualized with the same vis
P6	single technique	multiple techniques	only a single visualization technique is shown	different visualization techniques are shown
P6	single diagram	multi diagram	a single diagram is shown with a single visualization technique	multiple diagrams with the same technique
P7	single visualization	dashboard	only one visualization to do the analysis	multiple visualization schemes to support the analysis
P10	Multiple Visualizations	Single Visualization	multiple visualizations to present one data set	Single visualization to present one data set
P14	Single visualization	Aggregation of visualizations	This visualization does not consist of different clearly separated sub-visualizations.	These visualizations consist of a series of many sub-visualizations.
P5	time-vis	timeline-axis	temporal data is represented. but not on a timeline instead using a different representation for time	data is represented on a timeline with some form of time (years. quarters. etc)
P12	non-linear visualisation	linear visualisation	Darstellung als komische Form	Darstellung entlang einer Linie
P14	Unaligned data	Row-wise aligned data	In this visualization the values for a dataset can (theoretically) be found in the whole visualization area.	In these visualizations the individual datasets are separated into rows such that it is easy to follow their evolution in horizontal direction.
P3	Non-list-based	List-based	No linear list of data items is used as one axis	A linear list of categorical data items (no quantities) is used as one axis
P14	Unaligned positioning	Grid style	The positions of the dataset visualizations do not follow any known geometric style.	In these visualizations data is arranged very grid-like.
P6	gridless	coordinate system based	no spatial alignment	information is shown along horizontal and vertical axis

P7	no important orientation	orientation important	orientation is not that important	Orientation of the scheme is enough for commenting on the result
P5	Non-radial	Radial	data is represented in a non-circular way	A radial visualization is used (e.g. bubbles, circles, etc)
P3	Non-geo-related layout	Map-based	There is no geo-location of data items used for the layout	Layout is based on a geographic map
P6	abstract	spatial 1:1 mapping	spatial position does not represent spatial information	spatial position represents spatial information
P14	Location-free visualizations	Geographic embedding	This type of visualization describes data that need not be separated by locations.	These visualizations embed information into geographical maps and allow for locating data easily.
P14	High-density visualization	Isolated points	In this visualization almost the whole area is covered by data displaying as many datasets as possible.	These visualizations embed clearly separated circles that represent datasets with potentially much space in-between.
P6	sparse	dense	Lots of empty space in the visualization	The complete spaced is used to display information
P3	Visually sparse	Space-filling	Contains a lot of whitespace	Fills the available screen space with visual elements
P12	no space	enough space	no space between the elementsdie verschieden Linien wirken wie win Farbkleks. da kein Abstand zwischen ihnen ist. Vergleich dadurch auf den ersten Blick nicht möglich.	enough space between the elementsDurch genügend Abstand zwischen den einzelnen Balken. ist ein Vergleich auf den ersten Blick möglich.
P6	simple arrangement	complex arrangement	simple visual objects are shown	many different and complex shaped visual elements
P3	Complex	Simplistic	Visually complex with many visual elements	Visually simple graphics with limited complexity

## Data Related

P7	Non-temporal	Temporal	This relates precipitation and flight performance	We can compare the rate of crime with the justice retiring as well as the ruling party during the crime.
P13	no time	time	zeigt keine Schwankungen	zeigen Schwankungen



P4	No Time-Visualization	Time-Visualization	no time-dependent data	to visualize time-dependent data
P5	non-temporal data	temporal data	a different data type is visualized (non-temporal)	representation of temporal data
P7	Continuination	fixed set of duration	It starts from begining and goes and goes on	involves duration during which it was active
P11	few information	complex	Wenig Informationen	Viele Informationen
P11	one information	connected information	nur die Beziehung zwischen zwei Attribute werden gezeigt	Beziehungen zwischen mehrerern Attribute werden aufgezeigt
P12	a lot of information	few information	Menge der Informationen ist unübersichtlich. nicht auf einen Blick erkennbar	Übersichtliche Menge an Informationen in einer Darstellung
P12	1 information per category	more information per category	1 information per category	more information per category
P6	low information	high information density	low number data samples/points	high amount of data displayed
P5	non-geography	Geography	data represented is not concerned with a country or geography	Data of a country or representing geographical data
P3	Non-person-centered	Person-centered	Persons (humans) do not appear as data items	Uses persons (humans) as main data items
P7	non-text-based	text-based	based on volume data with time	based on text analysis
P3	Fun data	Serious data	Fun facts and data sets mainly interesting for leisure activities	Data sets focusing on serious applications. for instance. sciene or work-related

## Visual Experience

P4	not aesthetic	aesthetic	not appealing visualization	appealing visualization
P6	ugly	aestehtic	visual look is not pleasing	pleasing visual look and design
P10	Not pleasant to watch	Pleasant to watch	not harmonic colors and forms	Harmonic colors and forms
P13	not visually appealing	visually appealing	schreckt ab weiter zu lesen	invites to read more. ansprechender
P14	Arid visualizations	Visualization as art	These visualizations use only a few colors and the datasets are presented in a rather sparse way.	These visualizations can easily be used as art because they are widespread and colorful.
P11	simple	mystical	Einfach. langweilig	Macht neugierig. aber nicht leicht zu verstehen

P11	bare	playful	klar und einfach und direkt	verspielt. rätselhaft. indirekt. bildhaft
P4	easy to understand	difficult to understand	easy to understand the information of the data	difficult to understand the information of the data
P6	non-intuitive	intuitive	visualization is not directly understandable without detailed explanation	visualization is understandable with single labels
P10	confusing	Fast interpretation	long time necessary to intepret the data	fast interpretation of the data possible due to clear visualization
P11	difficult	intuitive	Nur mit Anleitung auszuwerten	intuitiv und schnell auswertbar
P12	good comprehensibility	bad comprehensibility	Die Aussage ist schnell und deutlich erkennbar.	Nicht ersichtlich. weshalb manche Informationen enthalten sind
P12	low clarity	high clarity	Einzelne Informationen sind zwar ablesbar. fallen aber nicht auf den ersten Blick ins Auge	Auf einen Blick erkennbar. was Zweck und Aussage des Schaubildes sind.
P7	Non-conclusive	conclusive	its very obvious and you cannot conclude anything out of it	just by a look you can draw some conclusion
P11	puzzling	descriptive	schwierig und kompliziert zu entschlüsseln	anschaulich. bildhaft. intuitiv verstehbar
P13	enough information (good)	too much information (bad)	ausreichend info um visualisierung zu verstehen	man braucht zu viel info um das diagramm zu verstehen
P3	Retro colors	Modern colors	Retro design colors. e.g.. black + neon colors	Modern design colors. e.g.. minimalistic design with bright colors
P10	Old-fashioned	Modern	gewöhnlich	mal was anderes
P4	specific visualization	well known visualizations	you have to learn/understand the visualization	(common standard visualization) easy to understand
P11	special visualization	common visualization	Ungewöhnliche Darstellung	allgemein bekannte Visualisierung
P11	pictorial	technical	intuitiv zu verstehen	genau präzise
P13	data only	more than data	reine datenmenge. die keine oder kaum querverbindungen (im gerhirn) zulässt	inhalte lassen querverbindungen über bloße daten hinaus zu