Who benefits from Visualization Adaptations? Towards a better Understanding of the Influence of Visualization Literacy

Appendix

In this appendix we provide additional tables and analysis that show data beyond the material that we could include in the short paper.

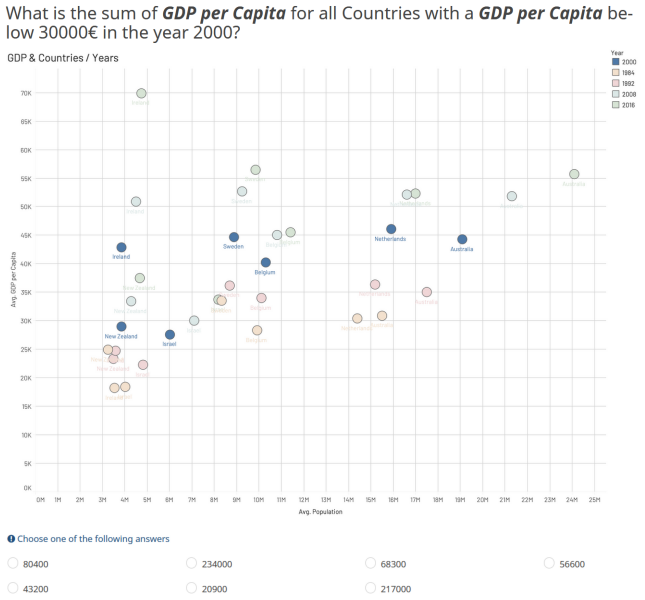

Figure A1: A screenshot of one task from the online study, depicting an example of the *Adapted Scatter Plot* condition. The group of the year 2000 is highlighted by de-emphasizing irrelevant points.

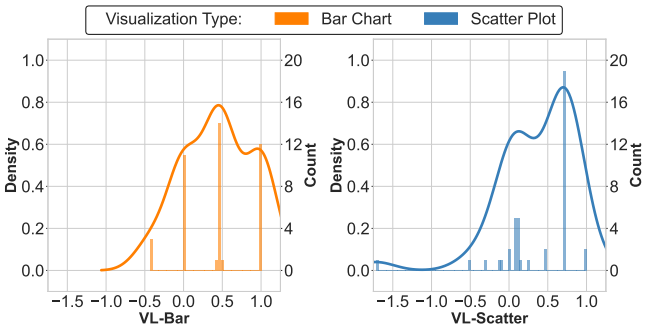

Figure A2: The kernel density estimation (KDE) plot (left y-axis) of the VL scores for both Visualization Types. Additionally, the number of VL scores (right y-axis) for each individual measured score is visible.

A Visualization Literacy Scores

Descriptive analyses of the distribution of the VL scores revealed that it differed from the distributions reported by Boy et al. [2] for both visualization types. Participants in our sample showed a much higher mean VL score of -0.43 to 1 ($M = 0.434$, 7 different scores) for *Bar Chart* and -1.72 to 1 ($M = 0.363$, 14 different scores) for *Scatter Plot*, whereas Boy et al. reported a score of -1.67 to 0.99 ($M = -0.39$, 21 different scores) for *Bar Chart* and -1.72 to 0.72 ($M = -0.14$, 23 different scores) for *Scatter Plot*. A reason for this divergence could be the mostly academic background of our participants. Since visualizations play a vital role in academic teaching, thinking, and work, it may be the case that subjects in our study have had more practice than the average population resulting in higher levels of VL [3]. The subjective ratings for different visualizations also confirm this. They show on a five-step rating scale medium to high familiarity ratings for bar charts ($M = 4.21, SD = 0.68$), and scatter plots ($M = 3.05, SD = 1.45$), and for line charts ($M = 3.86, SD = 0.90$). In general, Wilcoxon signed-rank tests showed a significant difference between both familiarities ($W(41) = 399, p < .001, r = .966$), while we didn't find such a significance for the VL scores ($W(41) = 418.5, p = .18, r = .257$) themselves. Additionally, we couldn't find a correlation between the VL for and familiarity for *Bar Charts* ($r_{Pearson} = .133, p = .399$) or *Scatter Plots* ($r_{Pearson} = .051, p = .749$).

References

[1] R. Amar, J. Eagan, and J. Stasko. Low-level components of analytic activity in information visualization. 2005. doi: 10.1109/INFVIS.2005.1532136

[2] J. Boy, R. A. Rensink, E. Bertini, and J. D. Fekete. A principled way of assessing visualization literacy. 2014. doi: 10.1109/TVCG.2014.2346984

[3] A. Maltese, D. Svetina, and J. Harsh. Research and Teaching: Data Visualization Literacy: Investigating Data Interpretation Along the Novice-Expert Continuum. 2015. doi: 10.2505/4/jcst15_045_01_84

Low-Level Analysis Task		Example Questions
Task 1	Task 2	
Filter	Compute Derived Value (Average)	What is the average Life Expectancy for the **5 Latin American** Countries below?
Filter	Range	What is the range of Values for Children per Women in **OECD** Countries?
Filter	Compute Derived Value (Sum)	What is the sum of GDP per Capita for all Countries with a GDP per Capita **above 3000$** in the year **2015**?
Filter	Compute Derived Value (Average)	What is the average Child Survival Rate for **East-European & Centr.-Asian Countries**?
Filter	Compute Derived Value (Count)	In how many regions is the Life Expectancy of **2006** above **70** years?

Table A1: All 5 task groups used in our study, which were created via a combination of two low-level analysis task [1]. The example questions represent one instance of this task group. The **bold** highlighted words in those questions were altered between the different repetitions, i.e., between the conditions.

Effect	Task Completion Time			Task Accuracy			Dependability			Usefulness			Intuitive Use		
	df	χ^2	p	df	χ^2	p	df	χ^2	p	df	χ^2	p	df	χ^2	p
VL	1	4.009	.045	1	0.746	.388	1	1.731	.188	1	0.785	.376	1	3.391	.066
Adaptation	1	20.43	< .001	1	2.702	.100	1	12.65	< .001	1	5.429	.020	1	6.160	.013
VL * Adaptation	1	8.882	.003	1	0.050	.824	1	2.870	.090	1	0.515	.473	1	0.194	.660
BIC		3527.682			393.081			287.674			309.694			291.323	

Table A2: ANOVAs comparing our models to the respecting reduced model in which the parameter corresponding to the effect is fixed to 0. All information are related to the Visualization Type of ***Bar Chart***. BIC is the abbreviation for Schwarz's Bayesian Criterion and measures the model fit by searching for the true model. (■: $p < .05$, ■: $p < .01$, ■: $p < .001$)

Effect	Task Completion Time			Task Accuracy			Dependability			Usefulness			Intuitive Use		
	df	χ^2	p	df	χ^2	p	df	χ^2	p	df	χ^2	p	df	χ^2	p
VL	1	6.365	.012	1	3.499	.061	1	1.079	.299	1	0.419	.517	1	3.354	.067
Adaptation	1	40.87	< .001	1	16.74	< .001	1	16.254	< .001	1	7.576	.006	1	14.832	< .001
VL * Adaptation	1	1.304	.254	1	0.059	.808	1	2.483	.115	1	0.142	.706	1	1.948	.163
BIC		3505.071			439.379			260.419			276.798			266.047	

Table A3: ANOVAs comparing our models to the respecting reduced model in which the parameter corresponding to the effect is fixed to 0. All information are related to the Visualization Type of ***Scatter Plot***. BIC is the abbreviation for Schwarz's Bayesian Criterion and measures the model fit by searching for the true model. (■: $p < .05$, ■: $p < .01$, ■: $p < .001$)

Term	Task Completion Time			Task Accuracy			Dependability			Usefulness			Intuitive Use		
	b	SE b	t	b	SE b	t	b	SE b	t	b	SE b	t	b	SE b	t
Baseline	43.07	5.279	8.158	1.122	.975	1.151	.790	.221	3.569	1.129	.241	4.677	.790	.229	3.451
VL	-7.046	3.343	-2.052	.346	.452	.765	.476	.358	1.329	.348	.390	.980	.696	.370	1.879
Adaptation	-4.430	.967	-4.583	.747	.390	1.914	.535	.139	3.842	.399	.166	2.407	.362	.141	2.576
VL * Adaptation	4.689	1.564	2.998	-.084	.322	-.261	-.388	.225	-1.723	-.193	.268	-.720	-.100	.227	-.441

Table A4: An overview of all fixed effect estimations for each dependent variable. All information are related to the Visualization Type of ***Bar Chart***. (■: $p < .05$, ■: $p < .01$, ■: $p < .001$)

Term	Task Completion Time			Task Accuracy			Dependability			Usefulness			Intuitive Use		
	b	SE b	t	b	SE b	t	b	SE b	t	b	SE b	t	b	SE b	t
Baseline	38.91	3.892	9.997	1.354	.420	3.225	1.040	.205	5.081	1.344	.204	6.594	1.000	.199	5.025
VL	-8.032	3.062	-2.623	.639	.361	1.769	.349	.333	1.045	.216	.332	.649	.606	.324	1.869
Adaptation	-5.368	.817	-6.571	.641	.155	4.126	.378	.085	4.455	.298	.104	2.882	.393	.093	4.218
VL * Adaptation	1.521	1.331	1.143	.157	.243	.646	-.221	.138	-1.599	.064	.169	.377	-.215	.152	-1.412

Table A5: An overview of all fixed effect estimations for each dependent variable. All information are related to the Visualization Type of ***Scatter Plot***. (■: $p < .05$, ■: $p < .01$, ■: $p < .001$)