

Form follows content: An empirical study on symbol-content (in)congruences in thematic maps

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Table S1. Mean valence of twelve topics, based on ratings of 116 participants.

	ID	Map topics	Min.	Max.	Mean	Standard Deviation
positive	1	City awarded for clean energy	-2	5	4.29	1.29
	2	National parks	-1	5	3.65	1.58
	3	Urban park with high biodiversity	-3	5	3.47	1.88
	4	Cities with excellent water quality	-4	5	4.06	1.62
neutral	5	Art colleges	-5	5	1.92	2.04
	6	Art galleries	-5	5	2.12	2.00
	7	Lookout tower	-2	5	2.45	1.87
	8	Outdoor stages	-2	5	2.15	1.85
negative	9	Floods	-5	4	-3.44	2.34
	10	Melting glaciers	-5	5	-3.41	2.40
	11	Traffic accident	-5	5	-3.04	2.74
	12	Smog polluted cities	-5	5	-3.25	2.52

Table S2. Map clusters: Conover-Iman test results.

Positive Map Cluster						
Pairwise Comparisons						
Differences:						
	Circle_pos	Triangle_pos	Rhomb_pos	Square_pos	AsymmStar_pos	Star_pos
Circle_pos	0.000	74.233	29.438	131.560	486.457	39.446
Triangle_pos	-74.233	0	-44.795	57.328	412.224	-34.787
Rhomb_pos	-29.438	44.795	0	102.123	457.019	10.009
Square_pos	-131.560	-57.328	-102.123	0	354.897	-92.114
AsymmStar_pos	-486.457	-412.224	-457.019	-354.897	0	-447.011
Star_pos	-39.446	34.787	-10.009	92.114	447.011	0
p-values:						
	Circle_pos	Triangle_pos	Rhomb_pos	Square_pos	AsymmStar_pos	Star_pos
Circle_pos	1.000	0.026	0.378	<0.0001	<0.0001	0.237
Triangle_pos	0.026	1	0.179	0.086	<0.0001	0.297
Rhomb_pos	0.378	0.179	1	0.002	<0.0001	0.764
Square_pos	<0.0001	0.086	0.002	1	<0.0001	0.006
AsymmStar_pos	<0.0001	<0.0001	<0.0001	<0.0001	1	<0.0001
Star_pos	0.237	0.297	0.764	0.006	<0.0001	1
<i>Bonferroni-corrected significance level: 0.0033</i>						
Neutral Map Cluster						
Pairwise Comparisons						
Differences:						
	Circle_neutra	Triangle_neutra	Rhomb_neutra	Square_neutra	AsymmStar_neutra	Star_neutra
	l	l	l	l	l	l
Circle_neutral	0.000	292.623	197.838	229.216	665.308	236.502
Triangle_neutral	-292.623	0	-94.784	-63.407	372.685	-56.121
Rhomb_neutral	-197.838	94.784	0	31.377	467.470	38.664
Square_neutral	-229.216	63.407	-31.377	0	436.093	7.287
AsymmStar_neutra l	-665.308	-372.685	-467.470	-436.093	0	-428.806
Star_neutral	-236.502	56.121	-38.664	-7.287	428.806	0
p-values:						
	Circle_pos	Triangle_pos	Rhomb_pos	Square_pos	AsymmStar_pos	Star_pos

Circle_pos	0.000	74.233	29.438	131.560	486.457	39.446
Triangle_pos	-74.233	0	-44.795	57.328	412.224	-34.787
Rhomb_pos	-29.438	44.795	0	102.123	457.019	10.009
Square_pos	-131.560	-57.328	-102.123	0	354.897	-92.114
AsymmStar_pos	-486.457	-412.224	-457.019	-354.897	0	-447.011
Star_pos	-39.446	34.787	-10.009	92.114	447.011	0

Bonferroni-corrected significance level: 0.0033

Negative Map Cluster

Pairwise Comparisons						
Differences:						
	Circle_neg	Triangle_neg	Rhomb_neg	Square_neg	AsymmStar_neg	Star_neg
Circle_neg	0.000	8.481	125.567	174.483	-244.433	-101.325
Triangle_neg	-8.481	0	117.086	166.002	-252.914	-109.806
Rhomb_neg	-125.567	-117.086	0	48.916	-370.000	-226.892
Square_neg	-174.483	-166.002	-48.916	0	-418.916	-275.808
AsymmStar_neg	244.433	252.914	370.000	418.916	0	143.108
Star_neg	101.325	109.806	226.892	275.808	-143.108	0

p-values:						
	Circle_neg	Triangle_neg	Rhomb_neg	Square_neg	AsymmStar_neg	Star_neg
Circle_neg	1.000	0.806	0.000	<0.0001	<0.0001	0.003
Triangle_neg	0.806	1	0.001	<0.0001	<0.0001	0.001
Rhomb_neg	0.000	0.001	1	0.156	<0.0001	<0.0001
Square_neg	<0.0001	<0.0001	0.156	1	<0.0001	<0.0001
AsymmStar_neg	<0.0001	<0.0001	<0.0001	<0.0001	1	<0.0001
Star_neg	0.003	0.001	<0.0001	<0.0001	<0.0001	1

Bonferroni-corrected significance level: 0.0033

Table S3. Map #1: Conover-Iman test results.

Map #1: City Awarded For Clean Energy						
Pairwise Comparisons						
Differences:						
	Circle	Triangle	Rhomb	Square	Asymm.Star	Star
Circle	0.000	42.381	23.690	44.117	147.714	-14.939
Triangle	-42.381	0	-18.691	1.736	105.333	-57.321
Rhomb	-23.690	18.691	0	20.427	124.024	-38.630
Square	-44.117	-1.736	-20.427	0	103.597	-59.057
Asymm.Star	-147.714	-105.333	-124.024	-103.597	0	-162.654
Star	14.939	57.321	38.630	59.057	162.654	0

p-values:						
	Circle	Triangle	Rhomb	Square	Asymm.Star	Star
Circle	1.000	0.007	0.112	0.005	<0.0001	0.337
Triangle	0.007	1	0.230	0.915	<0.0001	0.000
Rhomb	0.112	0.230	1	0.190	<0.0001	0.013
Square	0.005	0.915	0.190	1	<0.0001	0.000
Asymm.Star	<0.0001	<0.0001	<0.0001	<0.0001	1	<0.0001
Star	0.337	0.000	0.013	0.000	<0.0001	1

Bonferroni-corrected significance level: 0.0033

Table S4. Map #2: Conover-Iman test results.

Map #2: National Parks						
Pairwise Comparisons						
Differences:						
	Circle	Triangle	Rhomb	Square	Asymm.Star	Star
Circle	0.000	-30.329	-14.929	11.313	115.437	30.813
Triangle	30.329	0	15.400	41.642	145.765	61.142
Rhomb	14.929	-15.400	0	26.241	130.365	45.741
Square	-11.313	-41.642	-26.241	0	104.124	19.500
Asymm.Star	-115.437	-145.765	-130.365	-104.124	0	-84.624
Star	-30.813	-61.142	-45.741	-19.500	84.624	0

p-values:						
	Circle	Triangle	Rhomb	Square	Asymm.Star	Star
Circle	1.000	0.062	0.335	0.485	<0.0001	0.058
Triangle	0.062	1	0.342	0.014	<0.0001	0.000
Rhomb	0.335	0.342	1	0.106	<0.0001	0.005
Square	0.485	0.014	0.106	1	<0.0001	0.248
Asymm.Star	<0.0001	<0.0001	<0.0001	<0.0001	1	<0.0001
Star	0.058	0.000	0.005	0.248	<0.0001	1

Bonferroni-corrected significance level: 0.0033

Table S5. Map #3: Conover-Iman test results.

Map #3: Urban Park With High Biodiversity						
Pairwise Comparisons						
Differences:						
	Circle	Triangle	Rhomb	Square	Asymm.Star	Star
Circle	0.000	27.662	-1.538	46.963	74.594	-11.695
Triangle	-27.662	0	-29.199	19.302	46.933	-39.357
Rhomb	1.538	29.199	0	48.501	76.132	-10.158
Square	-46.963	-19.302	-48.501	0	27.631	-58.659
Asymm.Star	-74.594	-46.933	-76.132	-27.631	0	-86.290
Star	11.695	39.357	10.158	58.659	86.290	0

p-values:						
	Circle	Triangle	Rhomb	Square	Asymm.Star	Star
Circle	1.000	0.119	0.934	0.008	<0.0001	0.509
Triangle	0.119	1	0.100	0.254	0.008	0.020
Rhomb	0.934	0.100	1	0.006	<0.0001	0.566
Square	0.008	0.254	0.006	1	0.119	0.001
Asymm.Star	<0.0001	0.008	<0.0001	0.119	1	<0.0001
Star	0.509	0.020	0.566	0.001	<0.0001	1

Bonferroni-corrected significance level: 0.0033

Table S6. Map #4: Conover-Iman test results.

Map #4: Cities With Excellent Water Quality						
Pairwise Comparisons						
Differences:						
	Circle	Triangle	Rhomb	Square	Asymm.Star	Star
Circle	0.000	35.377	29.830	32.369	145.792	39.853
Triangle	-35.377	0	-5.547	-3.008	110.415	4.476
Rhomb	-29.830	5.547	0	2.539	115.962	10.023
Square	-32.369	3.008	-2.539	0	113.423	7.484
Asymm.Star	-145.792	-110.415	-115.962	-113.423	0	-105.939
Star	-39.853	-4.476	-10.023	-7.484	105.939	0

p-values:						
	Circle	Triangle	Rhomb	Square	Asymm.Star	Star
Circle	1.000	0.033	0.084	0.051	<0.0001	0.016
Triangle	0.033	1	0.737	0.849	<0.0001	0.777
Rhomb	0.084	0.737	1	0.878	<0.0001	0.545
Square	0.051	0.849	0.878	1	<0.0001	0.636
Asymm.Star	<0.0001	<0.0001	<0.0001	<0.0001	1	<0.0001
Star	0.016	0.777	0.545	0.636	<0.0001	1

Bonferroni-corrected significance level: 0.0033

Table S7. Map #5: Conover-Iman test results.

Map #5: Art College						
Pairwise Comparisons						
Differences:						
	Circle	Triangle	Rhomb	Square	Asymm.Star	Star
Circle	0.000	81.890	30.246	71.607	166.540	61.267

Triangle	-81.890	0	-51.644	-10.283	84.650	-20.623
Rhomb	-30.246	51.644	0	41.361	136.294	31.021
Square	-71.607	10.283	-41.361	0	94.933	-10.340
Asymm.Star	-166.540	-84.650	-136.294	-94.933	0	-105.272
Star	-61.267	20.623	-31.021	10.340	105.272	0

p-values:						
	Circle	Triangle	Rhomb	Square	Asymm.Star	Star
Circle	1.000	<0.0001	0.043	<0.0001	<0.0001	0.000
Triangle	<0.0001	1	0.001	0.527	<0.0001	0.205
Rhomb	0.043	0.001	1	0.008	<0.0001	0.048
Square	<0.0001	0.527	0.008	1	<0.0001	0.525
Asymm.Star	<0.0001	<0.0001	<0.0001	<0.0001	1	<0.0001
Star	0.000	0.205	0.048	0.525	<0.0001	1

Bonferroni-corrected significance level: 0.0033

Table S8. Map #6: Conover-Iman test results.

Map #6: Art Galleries						
Pairwise Comparisons						
Differences:						
	Circle	Triangle	Rhomb	Square	Asymm.Star	Star
Circle	0.000	87.111	70.492	83.432	181.262	57.205
Triangle	-87.111	0	-16.619	-3.679	94.151	-29.906
Rhomb	-70.492	16.619	0	12.940	110.770	-13.287
Square	-83.432	3.679	-12.940	0	97.830	-26.226
Asymm.Star	-181.262	-94.151	-110.770	-97.830	0	-124.057
Star	-57.205	29.906	13.287	26.226	124.057	0

p-values:						
	Circle	Triangle	Rhomb	Square	Asymm.Star	Star
Circle	1.000	<0.0001	<0.0001	<0.0001	<0.0001	0.000
Triangle	<0.0001	1	0.279	0.818	<0.0001	0.062
Rhomb	<0.0001	0.279	1	0.399	<0.0001	0.386
Square	<0.0001	0.818	0.399	1	<0.0001	0.101
Asymm.Star	<0.0001	<0.0001	<0.0001	<0.0001	1	<0.0001
Star	0.000	0.062	0.386	0.101	<0.0001	1

Bonferroni-corrected significance level: 0.0033

Table S9. Map #7: Conover-Iman test results.

Map #7: Lookout Tower						
Pairwise Comparisons						
Differences:						
	Circle	Triangle	Rhomb	Square	Asymm.Star	Star
Circle	0.000	53.333	57.453	47.619	179.660	79.881
Triangle	-53.333	0	4.120	-5.714	126.327	26.548
Rhomb	-57.453	-4.120	0	-9.834	122.208	22.428
Square	-47.619	5.714	9.834	0	132.041	32.262
Asymm.Star	-179.660	-126.327	-122.208	-132.041	0	-99.780
Star	-79.881	-26.548	-22.428	-32.262	99.780	0

p-values:						
	Circle	Triangle	Rhomb	Square	Asymm.Star	Star
Circle	1.000	0.001	0.001	0.003	<0.0001	<0.0001
Triangle	0.001	1	0.793	0.704	<0.0001	0.078
Rhomb	0.001	0.793	1	0.531	<0.0001	0.154
Square	0.003	0.704	0.531	1	<0.0001	0.032
Asymm.Star	<0.0001	<0.0001	<0.0001	<0.0001	1	<0.0001
Star	<0.0001	0.078	0.154	0.032	<0.0001	1

Bonferroni-corrected significance level: 0.0033

Table S10. Map #8: Conover-Iman test results.

Map #8: Outdoor Stages						
Pairwise Comparisons						
Differences:						
	Circle	Triangle	Rhomb	Square	Asymm.Star	Star
Circle	0.000	75.552	40.689	33.933	136.208	37.378
Triangle	-75.552	0	-34.863	-41.619	60.655	-38.175
Rhomb	-40.689	34.863	0	-6.756	95.519	-3.311
Square	-33.933	41.619	6.756	0	102.274	3.444
Asymm.Star	-136.208	-60.655	-95.519	-102.274	0	-98.830
Star	-37.378	38.175	3.311	-3.444	98.830	0
p-values:						
	Circle	Triangle	Rhomb	Square	Asymm.Star	Star
Circle	1.000	<0.0001	0.020	0.044	<0.0001	0.026
Triangle	<0.0001	1	0.038	0.010	0.000	0.018
Rhomb	0.020	0.038	1	0.687	<0.0001	0.843
Square	0.044	0.010	0.687	1	<0.0001	0.830
Asymm.Star	<0.0001	0.000	<0.0001	<0.0001	1	<0.0001
Star	0.026	0.018	0.843	0.830	<0.0001	1

Bonferroni-corrected significance level: 0.0033

Table S11. Map #9: Conover-Iman test results.

Map #9: Flood-Affected Area						
Pairwise Comparisons						
Differences:						
	Circle	Triangle	Rhomb	Square	Asymm.Star	Star
Circle	0.000	36.664	23.509	29.601	-60.434	-1.590
Triangle	-36.664	0	-13.155	-7.063	-97.098	-38.254
Rhomb	-23.509	13.155	0	6.091	-83.943	-25.099
Square	-29.601	7.063	-6.091	0	-90.035	-31.190
Asymm.Star	60.434	97.098	83.943	90.035	0	58.844
Star	1.590	38.254	25.099	31.190	-58.844	0
p-values:						
	Circle	Triangle	Rhomb	Square	Asymm.Star	Star
Circle	1.000	0.038	0.200	0.093	0.001	0.928
Triangle	0.038	1	0.455	0.675	<0.0001	0.023
Rhomb	0.200	0.455	1	0.729	<0.0001	0.154
Square	0.093	0.675	0.729	1	<0.0001	0.064
Asymm.Star	0.001	<0.0001	<0.0001	<0.0001	1	0.001
Star	0.928	0.023	0.154	0.064	0.001	1

Bonferroni-corrected significance level: 0.0033

Table S12. Map #10: Conover-Iman test results.

Map #10: Melting Glaciers						
Pairwise Comparisons						
Differences:						
	Circle	Triangle	Rhomb	Square	Asymm.Star	Star
Circle	0.000	-58.347	19.717	58.184	-24.670	-10.522
Triangle	58.347	0	78.064	116.532	33.678	47.825
Rhomb	-19.717	-78.064	0	38.467	-44.387	-30.239
Square	-58.184	-116.532	-38.467	0	-82.854	-68.706
Asymm.Star	24.670	-33.678	44.387	82.854	0	14.148
Star	10.522	-47.825	30.239	68.706	-14.148	0
p-values:						
	Circle	Triangle	Rhomb	Square	Asymm.Star	Star
Circle	1.000	0.001	0.272	0.001	0.169	0.541
Triangle	0.001	1	<0.0001	<0.0001	0.051	0.004
Rhomb	0.272	<0.0001	1	0.026	0.014	0.079

Square	0.001	<0.0001	0.026	1	<0.0001	<0.0001
Asymm.Star	0.169	0.051	0.014	<0.0001	1	0.411
Star	0.541	0.004	0.079	<0.0001	0.411	1

Bonferroni-corrected significance level: 0.0033

Table S13. Map #11: Conover-Iman test results.

Map #11: Traffic Accident						
Pairwise Comparisons						
Differences:						
	Circle	Triangle	Rhomb	Square	Asymm.Star	Star
Circle	0.000	1.082	36.087	41.601	-131.183	-99.267
Triangle	-1.082	0	35.006	40.519	-132.264	-100.349
Rhomb	-36.087	-35.006	0	5.513	-167.270	-135.355
Square	-41.601	-40.519	-5.513	0	-172.783	-140.868
Asymm.Star	131.183	132.264	167.270	172.783	0	31.915
Star	99.267	100.349	135.355	140.868	-31.915	0
p-values:						
	Circle	Triangle	Rhomb	Square	Asymm.Star	Star
Circle	1.000	0.937	0.006	0.003	<0.0001	<0.0001
Triangle	0.937	1	0.011	0.005	<0.0001	<0.0001
Rhomb	0.006	0.011	1	0.687	<0.0001	<0.0001
Square	0.003	0.005	0.687	1	<0.0001	<0.0001
Asymm.Star	<0.0001	<0.0001	<0.0001	<0.0001	1	0.020
Star	<0.0001	<0.0001	<0.0001	<0.0001	0.020	1

Bonferroni-corrected significance level: 0.0033

Table S14. Map #12: Conover-Iman test results.

Map #12: Smog-Polluted Cities						
Pairwise Comparisons						
Differences:						
	Circle	Triangle	Rhomb	Square	Asymm.Star	Star
Circle	0.000	33.247	46.468	43.587	-7.159	19.851
Triangle	-33.247	0	13.221	10.340	-40.406	-13.396
Rhomb	-46.468	-13.221	0	-2.882	-53.627	-26.618
Square	-43.587	-10.340	2.882	0	-50.745	-23.736
Asymm.Star	7.159	40.406	53.627	50.745	0	27.009
Star	-19.851	13.396	26.618	23.736	-27.009	0
p-values:						
	Circle	Triangle	Rhomb	Square	Asymm.Star	Star
Circle	1.000	0.067	0.007	0.016	0.679	0.273
Triangle	0.067	1	0.465	0.583	0.026	0.477
Rhomb	0.007	0.465	1	0.873	0.002	0.142
Square	0.016	0.583	0.873	1	0.005	0.208
Asymm.Star	0.679	0.026	0.002	0.005	1	0.136
Star	0.273	0.477	0.142	0.208	0.136	1

Bonferroni-corrected significance level: 0.0033