Toward Evaluating the Usefulness of Global Illumination for Novices in Lighting Design Tasks

Supplemental material: experiment results tables

This document contains the objectively measured data from all experiments and subjective ratings and rankings collected in the questionnaires. Furthermore we include the results of statistical analysis.

Preliminary questionnaire

This part of the questionnaire was given to subjects before the tests. It contained 3 questions about their previous experiences in fields relevant to the study with these possible answers:

(1) No experience
(2) Have tinkered with it
(3) Have worked on a project
(4) Have worked on more than one project
(5) Work as professional

	Previous knowledge		
	3D computer graphics	lighting design in 3D computer graphics	real world lighting design
Subject 1	1	1	1
Subject 2	2	1	1
Subject 3	1	1	1
Subject 4	1	1	2
Subject 5	1	1	1
Subject 6	1	1	1
Subject 7	2	1	2
Subject 8	1	1	1
Subject 9	2	1	2
Subject 10	4	2	1
Subject 11	2	1	2
Subject 12	1	1	2
Subject 13	1	1	1
Subject 14	1	1	1
Subject 15	1	1	2
Subject 16	1	1	1
Subject 17	1	1	4
Subject 18	1	1	1
Subject 19	3	2	1
Subject 20	2	1	3
Subject 21	4	4	4
Subject 22	1	1	1
Subject 23	1	1	1
Subject 24	1	1	1
Subject 25	2	1	1
Subject 26	1	1	2

Matching trials (Expts. 1–3)

Objective results

Objective results of the matching trials presented in the paper for all subjects. The two missing values for Subject 4 are caused by a hardware malfunction during testing.

	Experiment 1								Experiment 2								Experiment 3			
	Time to completion [s]				CIELAB error				Time to completion [s]				CIELAB error				Time to completion [s]		CIELAB error	
	Cartoon		Architecture		Cartoon		Architecture		Cartoon		Architecture		Cartoon		Architecture		Cart.	Arch.	Cart.	Arch.
	GI off	GI on	GI off	GI on	GI off	GI on	GI off	GI on	GI off	GI on	GI off	GI on	GI off	GI on	GI off	GI on				
Subject 1	125.0	483.8	221.4	210.4	4.97	9.92	4.06	10.55	107.2	70.0	297.0	103.4	5.52	1.62	3.37	6.44	109.8	394.8	6.29	4.56
Subject 2	123.8	260.6	226.0	355.8	5.70	14.75	3.45	1.05	257.6	193.4	248.6	167.2	2.89	3.00	2.41	5.45	248.4	327.4	2.58	4.11
Subject 3	173.6	366.8	239.8	448.4	6.38	5.82	4.82	5.94	160.2	122.2	369.2	481.2	7.64	2.95	4.64	7.32	260.6	421.0	7.18	6.16
Subject 4	219.6		297.8	222.4	7.02		4.45	4.46	279.8	107.0	204.2	207.0	5.85	2.84	4.42	8.88	309.0	368.2	2.54	4.23
Subject 5	345.4	205.2	351.0	129.2	18.44	4.63	10.46	7.42	240.2	195.6	282.2	463.6	4.50	1.25	4.43	6.51	154.0	350.4	5.03	5.34
Subject 6	264.6	173.4	197.0	195.4	2.10	3.04	3.68	3.45	268.8	153.4	215.6	293.6	2.32	1.55	1.89	2.59	279.4	454.4	2.68	3.86
Subject 7	261.4	267.0	270.6	481.2	5.75	2.49	5.85	8.19	211.4	94.4	255.8	270.8	1.54	3.46	9.00	6.76	248.2	446.8	3.60	2.03
Subject 8	151.0	331.8	195.2	281.6	5.41	4.60	2.13	2.11	114.6	248.4	328.6	283.4	2.83	5.26	3.37	3.75	481.4	259.8	8.72	2.47
Subject 9	56.8	47.8	125.8	213.8	1.91	12.85	4.50	12.96	125.6	73.8	99.6	245.8	6.49	7.58	13.35	8.44	157.0	172.2	11.30	12.17
Subject 10	150.0	173.6	229.4	188.0	8.48	7.78	1.31	0.99	176.8	153.6	192.4	165.4	5.05	3.20	4.79	1.60	205.8	264.4	1.12	5.04
Subject 11	199.8	224.2	352.0	259.4	3.91	4.46	0.98	0.56	176.2	207.8	269.2	223.4	5.56	5.20	0.84	5.07	270.0	304.6	6.57	3.27
Subject 12	84.6	193.8	187.4	381.8	3.05	3.61	3.12	12.26	158.8	257.6	210.2	123.6	3.72	6.64	2.93	7.47	210.6	252.0	4.94	14.86
Subject 13	204.2	197.6	194.8	473.4	7.40	5.13	7.32	13.05	238.6	324.0	280.4	246.2	3.16	5.42	1.95	6.11	469.6	412.8	5.63	9.29
Subject 14	121.0	167.8	299.4	126.4	6.62	7.02	2.46	6.27	100.4	142.8	168.2	250.2	3.09	3.15	5.18	3.95	154.6	213.0	1.52	9.01
Subject 15	179.2	205.8	108.0	201.8	9.24	7.25	2.40	7.33	86.0	105.6	141.2	241.8	4.58	8.77	5.57	9.13	159.4	118.6	5.36	6.85
Subject 16	240.8	230.0	367.2	323.2	2.50	5.89	4.46	2.89	426.2	117.2	454.4	479.0	2.36	1.20	2.48	7.15	346.8	477.4	3.15	6.25
Subject 17	146.0	174.2	289.6	236.6	3.77	3.09	4.79	7.05	181.2	213.6	345.4	245.4	9.10	1.19	5.56	3.29	282.8	129.4	3.31	8.20
Subject 18	134.6	481.2	235.0	224.8	5.83	7.04	0.56	5.64	79.4	248.6	203.6	189.2	3.56	3.38	2.86	2.46	260.4	218.8	6.96	1.23
Subject 19	151.0	216.6	481.2	315.6	7.26	8.80	19.40	3.86	93.2	410.2	257.0	214.6	3.54	4.08	2.14	3.66	177.0	385.4	3.97	3.09
Subject 20	116.6	125.6	245.4	344.0	5.06	19.84	5.00	14.10	71.8	98.2	169.2	350.2	3.44	4.03	11.09	8.28	122.6	123.8	3.80	4.04
Subject 21	80.0	179.4	85.8	252.6	6.81	4.29	2.38	2.66	129.0	115.4	171.4	146.2	6.76	1.43	1.04	1.03	166.0	126.2	3.61	6.98
Subject 22	313.8	351.6	481.4	416.4	3.60	4.14	14.84	3.88	400.4	319.6	481.2	197.8	5.84	4.73	4.11	5.25	312.6	290.6	2.62	4.22
Subject 23	144.4	137.0	174.0	216.0	6.76	4.07	2.59	4.18	67.4	108.4	178.4	176.0	3.65	3.24	4.76	3.09	188.2	234.2	2.16	3.74
Subject 24	227.8	199.6	142.8	141.2	6.01	3.11	4.61	3.28	140.8	186.2	340.2	196.4	3.01	5.00	4.42	8.61	140.4	258.4	6.49	5.44
Subject 25	96.2	92.0	106.2	137.8	5.53	7.58	3.96	4.75	68.2	54.4	115.8	146.8	3.47	4.67	5.70	4.04	132.2	207.4	8.07	2.77
Subject 26	267.8	156.2	443.8	182.0	4.31	4.25	11.45	5.68	162.4	178.0	325.8	189.8	6.02	2.58	13.02	2.92	176.6	158.0	4.23	7.50
Mean value	176.1	225.7	251.8	267.7	5.92	6.62	5.19	5.94	173.9	173.1	254.0	242.2	4.44	3.75	4.82	5.36	231.7	283.5	4.75	5.64
Standard error	14.5	21.3	21.5	20.9	0.62	0.82	0.85	0.76	18.7	17.2	18.8	19.9	0.36	0.39	0.65	0.47	19.0	22.0	0.48	0.62

Matching trials (Expts. 1–3)

Subjective results

Subjective results (questionnaire ratings) of matching trials presented in the paper for all subjects. The two missing values for Subject 4 are caused by a hardware malfunction during testing.

All ratings are on scale from 1 to 5 with 5 being most accurate for *Subjective matching accuracy* and easiest for *Subjective task difficulty*.

	Experiment 1								Experiment 2								Experiment 3			
	Subjective matching accuracy				Subjective task difficulty				Subjective matching accuracy				Subjective task difficulty				Subjective matching accuracy		Subjective task difficulty	
	Cartoon		Architecture		Cartoon		Architecture		Cartoon		Architecture		Cartoon		Architecture		Cart.	Arch.	Cart.	Arch.
	GI off	GI on	GI off	GI on	GI off	GI on	GI off	GI on	GI off	GI on	GI off	GI on	GI off	GI on	GI off	GI on				
Subject 1	5	3	5	4	5	3	4	4	5	5	5	5	5	5	4	4	5	4	5	4
Subject 2	4	3	4	3	5	4	4	3	3	4	4	4	3	4	3	4	4	4	3	3
Subject 3	4	4	4	3	5	4	5	3	3	4	3	1	4	4	3	1	4	1	3	1
Subject 4	5		5	5	3		2	4	5	5	5	5	2	5	2	3	5	4	2	2
Subject 5	4	4	4	4	4	4	3	4	4	4	4	2	4	4	3	2	4	4	4	3
Subject 6	4	4	3	3	5	5	4	4	4	4	3	3	4	4	4	3	3	2	4	3
Subject 7	5	3	4	1	5	3	4	1	5	4	3	2	5	4	3	2	3	1	2	1
Subject 8	5	4	5	4	5	4	5	4	5	4	4	4	5	4	3	3	3	4	2	4
Subject 9	4	4	5	2	4	4	4	2	4	4	5	2	4	4	4	2	4	4	3	3
Subject 10	3	5	4	4	4	4	3	3	4	4	4	4	3	3	2	2	4	2	4	2
Subject 11	5	4	4	5	5	4	3	3	3	4	3	3	3	4	2	3	4	4	2	1
Subject 12	5	5	2	3	5	5	4	3	5	3	5	4	4	3	4	4	4	3	3	1
Subject 13	4	4	5	2	2	3	4	1	4	3	4	4	4	2	4	4	3	4	1	2
Subject 14	4	4	2	3	3	3	2	2	4	4	3	2	3	4	2	3	4	2	3	2
Subject 15	3	4	5	4	3	2	4	4	4	4	3	3	4	4	4	3	4	4	3	4
Subject 16	4	4	3	4	5	4	3	4	3	4	2	1	2	5	2	1	4	3	3	2
Subject 17	5	4	4	4	4	4	3	3	5	4	3	4	3	2	3	3	3	5	3	5
Subject 18	4	2	5	3	3	2	4	4	5	4	4	3	4	3	3	3	3	4	3	2
Subject 19	4	4	2	4	4	3	1	2	4	4	4	4	4	3	2	3	4	3	3	2
Subject 20	4	3	4	4	3	3	2	1	4	3	4	2	2	3	2	1	4	4	3	3
Subject 21	5	4	5	4	5	4	5	4	4	5	4	5	5	5	4	5	4	4	3	3
Subject 22	4	5	1	3	3	4	1	3	3	4	4	3	4	5	3	3	5	5	4	4
Subject 23	5	5	5	4	5	5	4	4	5	5	4	4	5	5	4	3	5	3	4	3
Subject 24	4	4	4	4	5	4	5	5	4	4	3	3	5	4	3	3	4	4	4	3
Subject 25	5	5	5	4	5	5	4	4	5	5	4	4	5	5	4	4	5	4	5	4
Subject 26	4	5	2	4	4	4	2	4	5	5	3	5	5	4	3	3	4	5	3	3
Mean value	4.31	4.00	3.88	3.54	4.19	3.76	3.42	3.19	4.19	4.12	3.73	3.31	3.88	3.92	3.08	2.88	3.96	3.50	3.15	2.69
Mean value	0.12	0.15	0.24	0.18	0.18	0.17	0.23	0.21	0.15	0.12	0.15	0.23	0.19	0.17	0.16	0.19	0.13	0.22	0.18	0.21

Matching trials (Expts. 1–3)

Analysis results

Here are all results of the analysis presented in the paper, with additional effect size indicators and confidence intervals (CIs). Differences in the *Abs.* column are the absolute differences between the two compared trials, those in *Rel.* are divided by the mean value of the first trial in the comparison. Pairs of values for each confidence interval denote its lower and upper bound. *t-value* of the t-test is the value of test statistic, and *p-value* is the associated significance level of the test (the probability, that the difference of population is measured by chance).

		Mean paired difference		90% CI of mean paired difference				95% CI of of mean paired difference				Effect size		Paired t-test	
		Abs.	Rel.	Abs.		Rel.		Abs.		Rel.		Cohen's d	Pearson's r	t-value	p-value
Direct vs. indirect lighting comparison															
Time to completion [s]	Expt1 Cartoon scene	51.328	29.4%	10.257	92.399	5.9%	53.0%	1.783	100.873	1.0%	57.8%	0.570	0.274	2.138	0.043
	Expt1 Architecture scene	15.815	6.3%	-30.515	62.146	-12.1%	24.7%	-40.047	71.677	-15.9%	28.5%	0.149	0.074	0.583	0.565
	Expt2 Cartoon scene	-0.877	-0.5%	-40.194	38.441	-23.1%	22.1%	-48.283	46.529	-27.8%	26.8%	-0.010	-0.005	0.038	0.970
	Expt2 Architecture scene	-11.800	-4.6%	-49.132	25.532	-19.3%	10.1%	-56.812	33.212	-22.4%	13.1%	-0.122	-0.061	0.540	0.594
Matching error (CIELAB)	Expt1 Cartoon scene	0.746	12.7%	-1.084	2.576	-18.5%	43.9%	-1.461	2.954	-24.9%	50.3%	0.207	0.103	0.698	0.492
	Expt1 Architecture scene	0.751	14.5%	-1.135	2.637	-21.8%	50.8%	-1.523	3.025	-29.3%	58.3%	0.185	0.092	0.680	0.502
	Expt2 Cartoon scene	-0.694	-15.6%	-1.647	0.258	-37.1%	5.8%	-1.843	0.454	-41.5%	10.2%	-0.372	-0.183	1.245	0.225
	Expt2 Architecture scene	0.535	11.1%	-0.656	1.727	-13.6%	35.8%	-0.901	1.972	-18.7%	40.9%	0.188	0.094	0.768	0.450
Subjective acccuracy	Expt1 Cartoon scene	-0.280	-6.5%	-0.615	0.055	-14.4%	1.3%	-0.684	0.124	-16.0%	2.9%	-0.412	-0.202	1.429	0.166
	Expt1 Architecture scene	-0.346	-8.9%	-0.829	0.136	-21.3%	3.5%	-0.928	0.236	-23.9%	6.1%	-0.330	-0.163	1.225	0.232
	Expt2 Cartoon scene	-0.077	-1.8%	-0.344	0.190	-8.2%	4.5%	-0.398	0.245	-9.5%	5.8%	-0.116	-0.058	0.493	0.627
	Expt2 Architecture scene	-0.423	-11.3%	-0.780	-0.066	-20.9%	-1.8%	-0.853	0.007	-22.9%	0.2%	-0.429	-0.210	2.026	0.054
Subjective difficulty	Expt1 Cartoon scene	-0.480	-11.3%	-0.744	-0.216	-17.5%	-5.1%	-0.798	-0.162	-18.8%	-3.8%	-0.557	-0.268	3.116	0.005
	Expt1 Architecture scene	-0.231	-6.7%	-0.678	0.217	-19.8%	6.3%	-0.770	0.309	-22.5%	9.0%	-0.207	-0.103	0.881	0.387
	Expt2 Cartoon scene	0.038	1.0%	-0.358	0.435	-9.2%	11.2%	-0.439	0.516	-11.3%	13.3%	0.042	0.021	0.166	0.870
	Expt2 Architecture scene	-0.192	-6.3%	-0.492	0.108	-16.0%	3.5%	-0.554	0.169	-18.0%	5.5%	-0.218	-0.108	1.095	0.284
Key/Fill (Expt. 1 & 2) vs bounce (Expt. 3) lighting comparison															
Time to completion [s]	Expt1 vs. 3 Cartoon scene	2.872	1.3%	-39.324	45.068	-17.4%	20.0%	-48.030	53.774	-21.3%	23.8%	0.029	0.014	0.116	0.908
	Expt1 vs. 3 Architecture scene	15.800	5.9%	-23.978	55.579	-9.0%	20.8%	-32.161	63.762	-12.0%	23.8%	0.147	0.073	0.678	0.504
	Expt2 vs. 3 Cartoon scene	58.615	33.9%	25.759	91.472	14.9%	52.9%	19.000	98.231	11.0%	56.8%	0.646	0.308	3.047	0.005
	Expt2 vs. 3 Architecture scene	41.231	17.0%	0.781	81.681	0.3%	33.7%	-7.540	90.002	-3.1%	37.2%	0.392	0.193	1.741	0.094
Matching error (CIELAB)	Expt1 vs. 3 Cartoon scene	-1.784	-27.0%	-3.339	-0.229	-50.4%	-3.5%	-3.660	0.092	-55.3%	1.4%	-0.540	-0.261	1.963	0.061
	Expt1 vs. 3 Architecture scene	-0.301	-5.1%	-1.467	0.866	-24.7%	14.6%	-1.707	1.106	-28.7%	18.6%	-0.087	-0.043	0.441	0.663
	Expt2 vs. 3 Cartoon scene	0.999	26.7%	0.244	1.754	6.5%	46.8%	0.089	1.909	2.4%	50.9%	0.459	0.224	2.262	0.033
	Expt2 vs. 3 Architecture scene	0.288	5.4%	-0.857	1.433	-16.0%	26.8%	-1.092	1.669	-20.4%	31.2%	0.105	0.052	0.430	0.671
Subjective acccuracy	Expt1 vs. 3 Cartoon scene	-0.080	-2.0%	-0.340	0.180	-8.5%	4.5%	-0.393	0.233	-9.8%	5.8%	-0.116	-0.058	0.527	0.603
	Expt1 vs. 3 Architecture scene	-0.038	-1.1%	-0.411	0.334	-11.6%	9.4%	-0.488	0.411	-13.8%	11.6%	-0.039	-0.019	0.176	0.862
	Expt2 vs. 3 Cartoon scene	-0.154	-3.7%	-0.359	0.051	-8.7%	1.2%	-0.401	0.094	-9.8%	2.3%	-0.250	-0.124	1.280	0.212
	Expt2 vs. 3 Architecture scene	0.192	5.8%	-0.210	0.595	-6.3%	18.0%	-0.293	0.677	-8.8%	20.5%	0.171	0.085	0.817	0.422
Subjective difficulty	Expt1 vs. 3 Cartoon scene	-0.560	-14.9%	-0.903	-0.217	-24.0%	-5.8%	-0.974	-0.146	-25.9%	-3.9%	-0.655	-0.311	2.791	0.010
	Expt1 vs. 3 Architecture scene	-0.500	-15.7%	-0.916	-0.084	-28.7%	-2.6%	-1.001	0.001	-31.4%	0.0%	-0.467	-0.227	2.054	0.051
	Expt2 vs. 3 Cartoon scene	-0.769	-19.6%	-1.102	-0.437	-28.1%	-11.1%	-1.170	-0.368	-29.8%	-9.4%	-0.864	-0.397	3.953	0.001
	Expt2 vs. 3 Architecture scene	-0.192	-6.7%	-0.616	0.232	-21.4%	8.0%	-0.703	0.319	-24.4%	11.1%	-0.188	-0.094	0.775	0.446

Matching trials (Expts. 1–3)

Additional comparisons not presented in the paper

Differences in the *Abs.* column are the absolute differences between the two compared trials, those in *Rel.* are divided by the mean value of the first trial in the comparison. Pairs of values for each confidence interval denote its lower and upper bound. *t-value* of the t-test is the value of test statistic, and *p-value* is the associated significance level of the test (the probability, that the difference of population is measured by chance).

		Mean paired difference		90% CI of mean paired difference				95% CI of of mean paired difference				Effect size		Paired t-test	
		Abs.	Rel.	Abs.		Rel.		Abs.		Rel.		Cohen's d	Pearson's r	t-value	p-value
Key (Expt. 1) vs Fill (Expt. 2) lighting comparison															
Time to completion [s]	Cartoon scene	-27.344	-13.7%	-52.233	-2.455	-26.1%	-1.2%	-57.368	2.680	-28.7%	1.3%	-0.394	-0.193	1.880	0.072
	Architecture scene	-11.623	-4.5%	-37.758	14.513	-14.5%	5.6%	-43.135	19.889	-16.6%	7.7%	-0.144	-0.072	0.760	0.455
Matching error (CIELAB)	Cartoon scene	-2.161	-34.6%	-3.143	-1.179	-50.3%	-18.9%	-3.346	-0.976	-53.6%	-15.6%	-1.097	-0.481	3.765	0.001
	Architecture scene	-0.481	-8.6%	-1.428	0.466	-25.6%	8.4%	-1.623	0.661	-29.1%	11.9%	-0.183	-0.091	0.868	0.394
Subjective acccuracy	Cartoon scene	-0.020	-0.5%	-0.214	0.174	-5.2%	4.2%	-0.254	0.214	-6.1%	5.2%	-0.040	-0.020	0.176	0.862
	Architecture scene	-0.192	-5.2%	-0.514	0.129	-13.8%	3.5%	-0.580	0.195	-15.6%	5.3%	-0.238	-0.118	1.021	0.317
Subjective difficulty	Cartoon scene	-0.080	-2.0%	-0.362	0.202	-9.1%	5.1%	-0.421	0.261	-10.5%	6.5%	-0.106	-0.053	0.485	0.632
	Architecture scene	-0.327	-9.9%	-0.630	-0.024	-19.0%	-0.7%	-0.692	0.039	-20.9%	1.2%	-0.391	-0.192	1.842	0.077
Cartoon vs. Architecture scene comparison															
Time to completion [s]	Expt. 1	59.700	29.8%	32.024	87.376	16.0%	43.7%	26.314	93.086	13.2%	46.5%	0.784	0.365	3.691	0.001
	Expt. 2	74.639	43.0%	49.356	99.921	28.4%	57.6%	44.155	105.123	25.5%	60.6%	0.998	0.446	5.043	0.000
	Expt. 3	51.793	22.4%	13.338	90.248	5.8%	39.0%	5.427	98.159	2.3%	42.4%	0.504	0.244	2.301	0.030
Matching error (CIELAB)	Expt. 1	-0.632	-10.1%	-1.839	0.574	-29.4%	9.2%	-2.088	0.823	-33.4%	13.2%	-0.229	-0.114	0.897	0.379
	Expt. 2	0.993	24.3%	0.259	1.727	6.3%	42.2%	0.108	1.879	2.6%	45.9%	0.546	0.263	2.310	0.029
	Expt. 3	0.897	18.9%	-0.360	2.154	-7.6%	45.4%	-0.618	2.413	-13.0%	50.8%	0.326	0.161	1.219	0.234
Subjective acccuracy	Expt. 1	-0.480	-11.6%	-0.790	-0.170	-19.1%	-4.1%	-0.854	-0.106	-20.6%	-2.6%	-0.766	-0.358	2.646	0.014
	Expt. 2	-0.635	-15.3%	-0.874	-0.395	-21.0%	-9.5%	-0.923	-0.346	-22.2%	-8.3%	-0.904	-0.412	4.526	0.000
	Expt. 3	-0.462	-11.7%	-0.855	-0.068	-21.6%	-1.7%	-0.936	0.013	-23.6%	0.3%	-0.517	-0.250	2.004	0.056
Subjective difficulty	Expt. 1	-0.680	-17.0%	-0.984	-0.376	-24.6%	-9.4%	-1.047	-0.313	-26.2%	-7.8%	-0.802	-0.372	3.827	0.001
	Expt. 2	-0.923	-23.6%	-1.181	-0.665	-30.3%	-17.0%	-1.234	-0.612	-31.6%	-15.7%	-1.241	-0.527	6.108	0.000
	Expt. 3	-0.462	-14.6%	-0.819	-0.104	-26.0%	-3.3%	-0.893	-0.031	-28.3%	-1.0%	-0.466	-0.227	2.206	0.037

Open Trials (Expt. 4 – Lighting Transfer)

Objective results

Here are the objective results of lighting transfer trials presented in the paper for all subjects with time to completion added. The *Total lights used* columns are sum of respective *Key lights used* and *Fill lights used* columns.

Results of Subject 25 are invalid due to an error in test script, and are not included in the analysis of results.

The lighting models are

LM1: key lights limited in size, global illumination off,
LM2: arbitrary size key lights, global illumination off, and
LM3: arbitrary size key lights, global illumination on.

	Time to completion [s]						Key lights used						Fill lights used						Total lights used					
	Orion scene			Architecture scene			Orion scene			Architecture scene			Orion scene			Architecture scene			Orion scene			Architecture scene		
	LM1	LM2	LM3	LM1	LM2	LM3	LM1	LM2	LM3	LM1	LM2	LM3	LM1	LM2	LM3	LM1	LM2	LM3	LM1	LM2	LM3	LM1	LM2	LM3
Subject 1	376.8	471.2	546.4	680.4	484.0	589.4	0	2	1	5	6	3	1	1	2	1	2	1	1	3	3	6	8	4
Subject 2	451.0	280.8	571.2	876.2	864.8	738.0	3	1	2	9	4	7	1	1	1	2	3	1	4	2	3	11	7	8
Subject 3	756.4	425.2	261.0	762.0	479.8	680.6	1	2	2	3	4	2	1	0	1	8	0	2	2	2	3	11	4	4
Subject 4	444.2	674.6	420.0	458.6	554.6	666.2	0	2	1	2	3	1	2	4	2	3	3	4	2	6	3	5	6	5
Subject 5	563.6	718.0	510.2	700.4	696.4	615.8	2	1	4	7	5	7	1	2	0	3	2	2	3	3	4	10	7	9
Subject 6	475.2	435.6	268.6	449.4	708.8	631.8	2	2	1	3	3	2	2	1	1	2	4	3	4	3	2	5	7	5
Subject 7	497.4	343.6	369.6	595.8	609.8	660.0	1	2	1	3	5	6	2	1	2	2	2	2	3	3	3	5	7	8
Subject 8	543.0	389.4	691.0	791.6	895.2	658.2	1	1	1	6	5	1	1	0	1	3	2	1	2	1	2	9	7	2
Subject 9	331.8	339.2	330.6	503.2	488.8	587.0	1	1	1	6	3	4	1	1	1	4	1	2	2	2	2	10	4	6
Subject 10	312.2	693.0	318.0	603.8	458.2	686.2	1	2	1	4	2	12	1	2	2	2	1	0	2	4	3	6	3	12
Subject 11	419.2	324.8	654.6	379.4	610.6	552.4	1	2	0	1	4	6	2	2	2	3	3	0	3	4	2	4	7	6
Subject 12	178.0	401.0	776.4	674.8	515.4	737.8	2	1	4	8	8	7	0	0	0	1	2	1	2	1	4	9	10	8
Subject 13	508.2	590.8	636.0	753.2	461.2	363.2	1	2	2	3	4	2	1	1	1	2	2	0	2	3	3	5	6	2
Subject 14	901.2	245.0	468.0	449.2	597.2	558.6	2	3	2	4	7	2	3	0	0	8	0	3	5	3	2	12	7	5
Subject 15	432.8	485.6	431.2	652.8	515.0	454.4	0	1	0	3	3	2	3	1	2	3	3	2	3	2	2	6	6	4
Subject 16	729.2	829.0	872.0	886.0	718.6	894.0	3	2	3	2	6	5	1	1	1	3	1	1	4	3	4	5	7	6
Subject 17	591.8	607.2	422.2	743.2	685.2	449.8	3	1	1	4	6	2	1	2	0	1	2	2	4	3	1	5	8	4
Subject 18	520.4	763.2	737.2	726.4	857.4	571.2	2	1	2	2	2	3	1	1	0	2	4	2	3	2	2	4	6	5
Subject 19	600.0	463.0	444.2	682.4	705.0	641.2	2	1	2	6	3	4	1	0	0	2	2	1	3	1	2	8	5	5
Subject 20	550.8	529.0	892.0	901.4	517.2	465.6	1	2	2	5	2	7	2	1	1	0	2	0	3	3	3	5	4	7
Subject 21	544.6	532.4	500.6	858	811.2	793.6	2	3	3	4	6	5	1	0	0	2	0	0	3	3	3	6	6	5
Subject 22	239.8	550.2	838	548.4	500	525.4	1	2	3	3	2	2	2	1	0	4	2	2	3	3	3	7	4	4
Subject 23	569.4	419.4	706.8	826.6	800	530.8	2	0	3	2	7	3	1	3	0	3	3	1	3	3	3	5	10	4
Subject 24	183.2	345.4	352	285.6	342	243.6	2	3	2	4	2	2	0	0	1	0	1	1	2	3	3	4	3	3
Subject 25																								
Subject 26	411.82	888	349.6	306.6	501.2	363	1	1	1	1	2	1	1	1	1	1	1	2	2	2	2	2	3	3
Mean value	485.3	509.8	534.7	643.8	615.1	586.3	1.48	1.64	1.80	4.00	4.16	3.92	1.32	1.08	0.88	2.60	1.92	1.44	2.80	2.72	2.68	6.60	6.08	5.36
Standard error	33.8	34.7	38.6	36.2	30.1	28.9	0.17	0.15	0.22	0.42	0.37	0.54	0.15	0.20	0.16	0.39	0.22	0.21	0.18	0.21	0.15	0.53	0.39	0.46

Open Trials (Expt. 4 – Lighting Transfer)

Subjective results

Here are the subjective results of lighting transfer trials presented in the paper for all subjects. All values are ratings on scale of 1 to 5, with 5 being Most satisfied for *Subjective satisfaction with result*, easiest for *Subjective task difficulty*, and least restrictive for *Subjective restrictiveness of lighting model*.

Results of Subject 25 are invalid due to an error in test script, and are not included in the analysis of results.

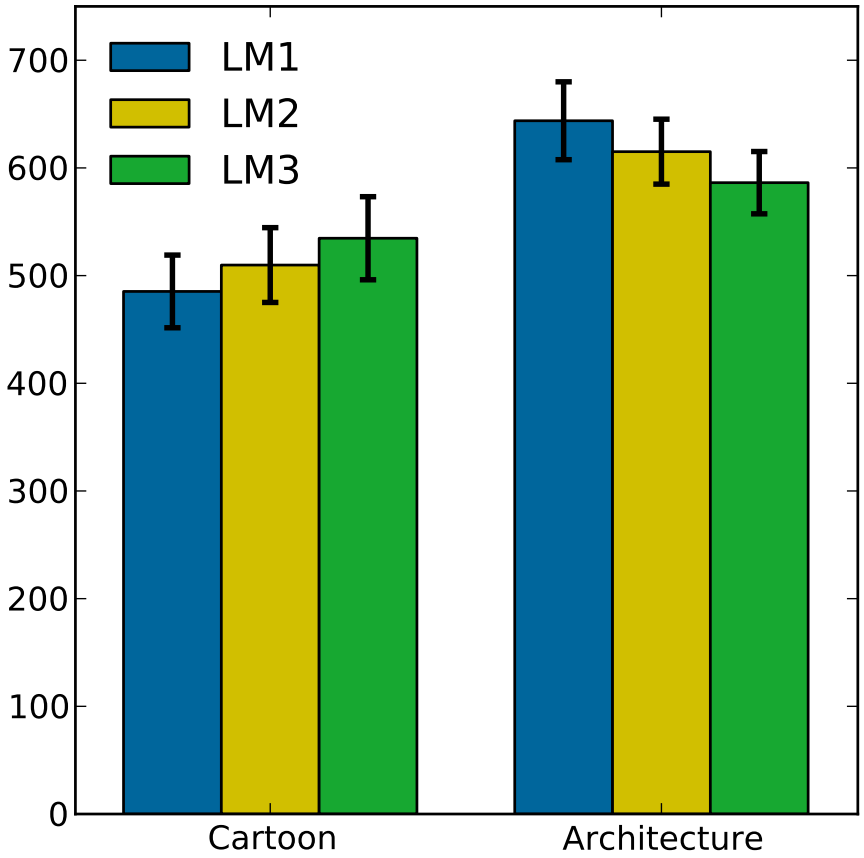
The lighting models are

LM1: key lights limited in size, global illumination off,
LM2: arbitrary size key lights, global illumination off, and
LM3: arbitrary size key lights, global illumination on.

	Subj. satisfaction with result						Subj. task difficulty						Subj. restrictiveness of LM					
	Orion scene			Architecture scene			Orion scene			Architecture scene			Orion scene			Architecture scene		
	LM1	LM2	LM3	LM1	LM2	LM3	LM1	LM2	LM3	LM1	LM2	LM3	LM1	LM2	LM3	LM1	LM2	LM3
Subject 1	4	5	4	3	5	4	4	3	3	2	4	3	5	5	4	3	5	4
Subject 2	3	3	2	3	3	2	3	2	2	3	2	1	4	5	5	5	5	5
Subject 3	3	3	3	3	4	2	3	3	4	2	4	2	4	2	3	3	5	4
Subject 4	4	3	4	4	3	3	3	2	3	3	2	2	4	4	5	5	3	4
Subject 5	4	4	3	4	4	3	4	2	3	3	2	3	4	3	3	3	3	3
Subject 6	4	3	4	2	2	3	3	3	4	2	3	3	3	4	4	3	4	3
Subject 7	4	3	5	2	2	5	5	4	4	1	3	5	5	2	5	1	3	5
Subject 8	3	4	4	4	3	3	3	4	3	3	1	2	5	5	5	5	5	5
Subject 9	2	3	4	4	3	4	3	3	4	4	3	4	5	5	5	5	5	5
Subject 10	3	4	3	2	1	4	4	4	4	3	2	4	2	4	4	2	2	3
Subject 11	2	3	1	1	2	4	2	4	1	2	2	4	4	5	2	1	2	5
Subject 12	4	3	4	1	4	3	4	3	3	1	4	2	1	5	2	1	5	4
Subject 13	3	4	2	3	4	2	3	3	2	3	4	4	2	2	4	4	3	4
Subject 14	1	5	4	4	4	5	1	5	2	3	4	3	1	5	3	4	5	3
Subject 15	2	2	3	1	3	2	2	1	2	1	2	1	3	3	3	2	4	3
Subject 16	3	2	1	3	3	3	4	2	2	2	2	4	5	4	5	3	5	5
Subject 17	4	5	5	2	3	5	3	3	4	1	2	4	4	3	5	1	1	5
Subject 18	2	3	3	3	3	4	2	3	2	2	2	4	3	4	3	2	4	4
Subject 19	4	4	4	4	3	4	2	3	2	2	2	3	4	5	5	5	3	5
Subject 20	3	3	1	2	2	2	3	3	1	1	2	3	4	4	4	4	4	4
Subject 21	4	4	5	4	5	4	3	3	4	2	3	2	5	5	5	4	5	4
Subject 22	5	4	3	4	4	3	5	2	3	3	4	4	4	3	3	3	4	4
Subject 23	3	4	3	2	3	3	3	3	2	1	3	2	4	5	5	4	5	5
Subject 24	4	3	4	4	3	4	4	4	4	5	4	3	5	4	4	5	3	4
Subject 25																		
Subject 26	3	5	3	2	4	2	2	4	3	1	3	2	2	5	3	1	5	2
Mean value	3.24	3.56	3.28	2.84	3.20	3.32	3.12	3.04	2.84	2.24	2.76	2.96	3.68	4.04	3.96	3.16	3.92	4.08
Standard error	0.19	0.17	0.23	0.21	0.19	0.20	0.19	0.18	0.20	0.21	0.19	0.21	0.25	0.21	0.20	0.29	0.24	0.17

Open Trials (Expt. 4 – Lighting Transfer)

Time to completion graph



Open trials (Expt. 4 – Lighting Transfer)

Analysis results

Here are all results of the analysis presented in the paper, with additional effect size indicators and confidence intervals (CIs). Differences in the *Abs.* column are the absolute differences between the two compared trials, those in *Rel.* are divided by the mean value of the first trial in the comparison. Pairs of values for each confidence interval denote its lower and upper bound. *t-value* of the t-test is the value of test statistic, and *p-value* is the associated significance level of the test (the probability, that the difference of population is measured by chance).

		Mean paired difference		90% CI of mean paired difference				95% CI of of mean paired difference				Effect size		Paired t-test	
		Abs.	Rel.	Abs.		Rel.		Abs.		Rel.		Cohen's d	Pearson's r	t-value	p-value
LM1 (small key lights) vs. LM2 (direct lighting) comparison															
Time to completion	Cartoon scene	24.503	5.0%	-57.031	106.037	-11.8%	21.9%	-73.854	122.860	-15.2%	25.3%	0.146	0.073	0.514	0.612
	Architecture scene	-28.712	-4.5%	-85.221	27.798	-13.2%	4.3%	-96.881	39.458	-15.0%	6.1%	-0.176	-0.088	0.869	0.393
Key lights used	Cartoon scene	0.160	10.8%	-0.255	0.575	-17.3%	38.9%	-0.341	0.661	-23.0%	44.7%	0.200	0.100	0.659	0.516
	Architecture scene	0.160	4.0%	-0.670	0.990	-16.8%	24.8%	-0.842	1.162	-21.0%	29.0%	0.083	0.042	0.330	0.745
Fill lights used	Cartoon scene	-0.240	-18.2%	-0.626	0.146	-47.4%	11.1%	-0.706	0.226	-53.5%	17.1%	-0.278	-0.138	1.063	0.298
	Architecture scene	-0.680	-26.2%	-1.556	0.196	-59.9%	7.6%	-1.737	0.377	-66.8%	14.5%	-0.439	-0.215	1.327	0.197
Total lights used	Cartoon scene	-0.080	-2.9%	-0.553	0.393	-19.7%	14.0%	-0.650	0.490	-23.2%	17.5%	-0.082	-0.041	0.289	0.775
	Architecture scene	-0.520	-7.9%	-1.575	0.535	-23.9%	8.1%	-1.793	0.753	-27.2%	11.4%	-0.228	-0.113	0.843	0.407
Subjective satisfaction with result	Cartoon scene	0.320	9.9%	-0.084	0.724	-2.6%	22.3%	-0.167	0.807	-5.2%	24.9%	0.364	0.179	1.355	0.188
	Architecture scene	0.360	12.7%	-0.021	0.741	-0.7%	26.1%	-0.100	0.820	-3.5%	28.9%	0.362	0.178	1.616	0.119
Subjective task difficulty	Cartoon scene	-0.080	-2.6%	-0.573	0.413	-18.4%	13.2%	-0.675	0.515	-21.6%	16.5%	-0.088	-0.044	0.278	0.784
	Architecture scene	0.520	23.2%	0.077	0.963	3.4%	43.0%	-0.014	1.054	-0.6%	47.1%	0.536	0.259	2.008	0.056
Subjective restrictiveness of LM	Cartoon scene	0.360	9.8%	-0.206	0.926	-5.6%	25.2%	-0.323	1.043	-8.8%	28.3%	0.317	0.157	1.087	0.288
	Architecture scene	0.760	24.1%	0.216	1.304	6.8%	41.3%	0.104	1.416	3.3%	44.8%	0.582	0.280	2.392	0.025
LM1 (small key lights) vs. LM3 (indirect lighting) comparison															
Time to completion	Cartoon scene	49.415	10.2%	-38.307	137.137	-7.9%	28.3%	-56.407	155.237	-11.6%	32.0%	0.278	0.138	0.964	0.345
	Architecture scene	-57.504	-8.9%	-116.229	1.221	-18.1%	0.2%	-128.346	13.338	-19.9%	2.1%	-0.358	-0.176	1.675	0.107
Key lights used	Cartoon scene	0.320	21.6%	-0.018	0.658	-1.2%	44.5%	-0.088	0.728	-5.9%	49.2%	0.333	0.164	1.619	0.119
	Architecture scene	-0.080	-2.0%	-1.001	0.841	-25.0%	21.0%	-1.191	1.031	-29.8%	25.8%	-0.034	-0.017	0.149	0.883
Fill lights used	Cartoon scene	-0.440	-33.3%	-0.754	-0.126	-57.1%	-9.6%	-0.818	-0.062	-62.0%	-4.7%	-0.587	-0.282	2.400	0.024
	Architecture scene	-1.160	-44.6%	-1.774	-0.546	-68.2%	-21.0%	-1.901	-0.419	-73.1%	-16.1%	-0.761	-0.356	3.231	0.004
Total lights used	Cartoon scene	-0.120	-4.3%	-0.565	0.325	-20.2%	11.6%	-0.657	0.417	-23.5%	14.9%	-0.147	-0.073	0.461	0.649
	Architecture scene	-1.240	-18.8%	-2.301	-0.179	-34.9%	-2.7%	-2.519	0.039	-38.2%	0.6%	-0.510	-0.247	2.000	0.057
Subjective satisfaction with result	Cartoon scene	0.040	1.2%	-0.373	0.453	-11.5%	14.0%	-0.458	0.538	-14.1%	16.6%	0.039	0.019	0.166	0.870
	Architecture scene	0.480	16.9%	0.026	0.934	0.9%	32.9%	-0.068	1.028	-2.4%	36.2%	0.476	0.232	1.809	0.083
Subjective task difficulty	Cartoon scene	-0.280	-9.0%	-0.630	0.070	-20.2%	2.2%	-0.702	0.142	-22.5%	4.5%	-0.292	-0.144	1.371	0.183
	Architecture scene	0.720	32.1%	0.241	1.199	10.8%	53.5%	0.142	1.298	6.3%	57.9%	0.696	0.329	2.571	0.017
Subjective restrictiveness of LM	Cartoon scene	0.280	7.6%	-0.083	0.643	-2.3%	17.5%	-0.158	0.718	-4.3%	19.5%	0.251	0.124	1.319	0.200
	Architecture scene	0.920	29.1%	0.407	1.433	12.9%	45.3%	0.302	1.538	9.5%	48.7%	0.782	0.364	3.071	0.005

		Mean paired difference		90% CI of mean paired difference				95% CI of of mean paired difference				Effect size		Paired t-test	
		Abs.	Rel.	Abs.		Rel.		Abs.		Rel.		Cohen's d	Pearson's r	t-value	p-value
LM2 (direct lighting) vs. LM3 (indirect) comparison															
Time to completion	Cartoon scene	24.912	4.9%	-57.712	107.535	-11.3%	21.1%	-74.760	124.583	-14.7%	24.4%	0.139	0.069	0.516	0.611
	Architecture scene	-28.792	-4.7%	-79.958	22.373	-13.0%	3.6%	-90.515	32.931	-14.7%	5.4%	-0.199	-0.099	0.963	0.345
Key lights used	Cartoon scene	0.160	9.8%	-0.300	0.620	-18.3%	37.8%	-0.395	0.715	-24.1%	43.6%	0.175	0.087	0.595	0.557
	Architecture scene	-0.240	-5.8%	-1.332	0.852	-32.0%	20.5%	-1.558	1.078	-37.4%	25.9%	-0.107	-0.053	0.376	0.710
Fill lights used	Cartoon scene	-0.200	-18.5%	-0.570	0.170	-52.7%	15.7%	-0.646	0.246	-59.8%	22.8%	-0.228	-0.113	0.926	0.364
	Architecture scene	-0.480	-25.0%	-0.955	-0.005	-49.7%	-0.3%	-1.053	0.093	-54.8%	4.8%	-0.454	-0.221	1.729	0.097
Total lights used	Cartoon scene	-0.040	-1.5%	-0.453	0.373	-16.7%	13.7%	-0.538	0.458	-19.8%	16.8%	-0.044	-0.022	0.166	0.870
	Architecture scene	-0.720	-11.8%	-1.749	0.309	-28.8%	5.1%	-1.961	0.521	-32.3%	8.6%	-0.344	-0.169	1.197	0.243
Subjective satisfaction with result	Cartoon scene	-0.280	-7.9%	-0.681	0.121	-19.1%	3.4%	-0.764	0.204	-21.5%	5.7%	-0.277	-0.137	1.193	0.244
	Architecture scene	0.120	3.7%	-0.377	0.617	-11.8%	19.3%	-0.480	0.720	-15.0%	22.5%	0.126	0.063	0.413	0.683
Subjective task difficulty	Cartoon scene	-0.200	-6.6%	-0.619	0.219	-20.4%	7.2%	-0.706	0.306	-23.2%	10.1%	-0.217	-0.108	0.816	0.422
	Architecture scene	0.200	7.2%	-0.263	0.663	-9.5%	24.0%	-0.359	0.759	-13.0%	27.5%	0.205	0.102	0.739	0.467
Subjective restrictiveness of LM	Cartoon scene	-0.080	-2.0%	-0.563	0.403	-13.9%	10.0%	-0.663	0.503	-16.4%	12.4%	-0.079	-0.039	0.283	0.779
	Architecture scene	0.160	4.1%	-0.360	0.680	-9.2%	17.3%	-0.467	0.787	-11.9%	20.1%	0.157	0.078	0.527	0.603

Open Trials (Expt. 5 – Free Lighting)

Here are the both objective and subjective results of the free experimentation trials for all subjects. The *GI enabled* column shows the state of global illumination button when users decide to end each task.

The second part of the table shows subjective ratings (on scale from 1 to 5 with 5 being the most useful) and rankings (with 1st being most useful) of 3 lighting model features:

KEY: Arbitrary size key lights,
FILL: Fill lights, and
GI: Global illumination.

There are two values missing where one subject provided invalid ranking.

	Objective results										Subjective results - Feature usefulness								
	Time to completion [s]		Key lights used		Fill lights used		Total lights used		GI enabled		Rating						Ranking		
											Still life			Office					
	Still life	Office	Still life	Office	Still life	Office	Still life	Office	Still life	Office	KEY	FILL	GI	KEY	FILL	GI	1st	2nd	3rd
Subject 1	585.0	325.4	2	3	1	1	3	4	yes	yes	4	4	4	5	3	4	GI	KEY	FILL
Subject 2	892.6	518.2	6	3	1	2	7	5	yes	yes	4	3	3	3	3	4	GI	FILL	KEY
Subject 3	857.2	307.6	1	3	2	1	3	4	no	yes	4	5	4	5	5	3	KEY	GI	FILL
Subject 4	663.4	783.6	2	3	2	1	4	4	no	yes	4	4	2	4	4	3	KEY	GI	FILL
Subject 5	555.4	850.6	3	2	0	5	3	7	no	yes	5	4	3	5	5	3	FILL	KEY	GI
Subject 6	396.4	379.6	2	4	2	0	4	4	yes	no	3	4	4	5	1	1	FILL	GI	KEY
Subject 7	365.2	457.2	2	2	0	0	2	2	yes	yes	5	1	4	3	3	5	KEY	GI	FILL
Subject 8	879.0	820.8	2	5	1	0	3	5	no	yes	5	4	2	5	2	4	KEY	FILL	GI
Subject 9	653.8	716.6	3	4	0	0	3	4	yes	yes	5	2	4	5	3	3	KEY	GI	FILL
Subject 10	761.4	887.4	4	4	0	1	4	5	yes	no	5	1	3	5	3	3	KEY		
Subject 11	653.2	388.8	1	2	2	1	3	3	yes	yes	5	1	3	5	3	5	KEY	GI	FILL
Subject 12	427.2	500.0	1	1	0	1	1	2	no	yes	5	1	3	3	5	4	KEY	FILL	GI
Subject 13	478.2	674.2	1	2	1	1	2	3	yes	yes	5	2	4	5	3	5	KEY	GI	FILL
Subject 14	888.0	856.4	5	1	0	5	5	6	yes	yes	5	1	4	5	4	4	KEY	GI	FILL
Subject 15	861.2	883.8	4	4	1	1	5	5	yes	yes	4	3	5	4	2	5	GI	KEY	FILL
Subject 16	895.6	901.2	3	2	0	2	3	4	yes	yes	5	2	4	4	4	5	KEY	GI	FILL
Subject 17	364.6	673.2	1	2	0	1	1	3	yes	yes	5	1	3	5	3	5	KEY	GI	FILL
Subject 18	901.2	901.2	3	6	1	0	4	6	no	no	5	4	3	4	3	3	KEY	FILL	GI
Subject 19	877.4	836.8	3	4	2	2	5	6	yes	no	5	4	4	5	4	3	KEY	GI	FILL
Subject 20	657.6	617.0	3	1	0	1	3	2	yes	yes	4	4	4	4	3	3	KEY	GI	FILL
Subject 21	457.0	746.6	2	3	0	0	2	3	no	yes	5	1	3	5	3	3	KEY	GI	FILL
Subject 22	449.0	482.6	1	1	1	3	2	4	yes	no	5	4	3	5	4	2	KEY	FILL	GI
Subject 23	769.6	554.6	5	3	2	2	7	5	yes	yes	5	4	5	4	5	5	GI	KEY	FILL
Subject 24	391.2	402.8	2	1	1	2	3	3	no	no	5	3	3	4	4	3	KEY	GI	FILL
Subject 25	527.0	451.4	2	1	1	2	3	3	no	yes	5	3	3	5	5	3	KEY	FILL	GI
Subject 26	481.4	428.0	1	2	1	2	2	4	no	yes	5	3	3	4	4	2	KEY	FILL	GI
Mean value	641.9	628.7	2.50	2.65	0.85	1.42	3.35	4.08			4.69	2.81	3.46	4.46	3.50	3.58			
Standard Error	38.5	39.9	0.27	0.27	0.15	0.26	0.30	0.26			0.11	0.26	0.15	0.14	0.20	0.22			

Open Trials (Expt. 5 – Free Lighting)

Analysis results

Here are all results of the analysis presented in the paper, with additional effect size indicators and confidence intervals (CIs). Differences in the *Abs.* column are the absolute differences between the two compared trials, those in *Rel.* are divided by the mean value of the first trial in the comparison. Pairs of values for each confidence interval denote its lower and upper bound. *t-value* of the t-test is the value of test statistic, and *p-value* is the associated significance level of the test (the probability, that the difference of population is measured by chance).

	Mean paired difference		90% CI of mean paired difference				95% CI of of mean paired difference				Effect size		Paired t-test	
	Abs.	Rel.	Abs.		Rel.		Abs.		Rel.		Cohen's d	Pearson's r	t-value	p-value
Usefulness of arbitrary size key lights vs. fill lights														
Still life scene	-1.885	-40.2%	-2.440	-1.329	-52.0%	-28.3%	-2.554	-1.215	-54.4%	-25.9%	-1.892	-0.687	5.799	0.000
Office scene	-0.962	-21.6%	-1.401	-0.522	-31.4%	-11.7%	-1.491	-0.432	-33.4%	-9.7%	-1.111	-0.486	3.740	0.001
Usefulness of arbitrary size key lights vs. indirect lighting														
Still life scene	-1.231	-26.2%	-1.576	-0.885	-33.6%	-18.9%	-1.648	-0.814	-35.1%	-17.3%	-1.892	-0.687	6.082	0.000
Office scene	-0.885	-19.8%	-1.371	-0.398	-30.7%	-8.9%	-1.471	-0.298	-33.0%	-6.7%	-0.975	-0.438	3.108	0.005
Usefulness of fill lights vs. indirect lighting														
Still life scene	0.654	23.3%	0.153	1.155	5.4%	41.1%	0.050	1.258	1.8%	44.8%	0.616	0.295	2.230	0.035
Office scene	0.077	2.2%	-0.424	0.578	-12.1%	16.5%	-0.527	0.681	-15.1%	19.4%	0.074	0.037	0.262	0.795