Diminishing Returns in Perceptual Color Space – Now in Color Supplemental Material

Emily Stark, Terece L. Turton, Roxana Bujack

1 Experimental Methodology

1.1 Materials

Triads are constructed from sampling colors along the two lines described in the paper (green to pink and blue to orange). Approximately equal step sizes in ΔE^*_{00} were used to generate the bank of colors. These colors were used to design experimental triads, selecting three centers along each line with equal spacing between them. A full list of triads can be seen in Tables 1 and 2. For all colors, $L^* = 70$. A visualization of the differences between the standard and tests is seen in Figure 1. The triads were presented on a gray background with $L^* = 25, a^* = 0, b^* = 0$.

For all colors, $L^* = 70$. A visualization of the differences between the standard and tests is seen in Figure 1. Triads were presented on a gray background, $L^* = 25, a^* = 0, b^* = 0$. Example stimuli for the blue to orange line are shown in Figure 2.

1.2 Procedure

This study was administered on a computer via a web browser. An internal Qualtrics check was used to ensure that participants were not on a cellphone or tablet. Participants were shown a subset of experimental triads, presenting them one at a time in random order. The left/right positions of the tests were randomized and the standard was always presented in the middle. Triads were arranged in a straight line. Participants were instructed to press "q" to indicate that the test on the left is more different from the middle, and "p" if the test on the right is more different. Participants completed three training rounds to get acclimated to the task. After they made their selection the triad disappeared and participants were given feedback regarding whether they made the correct selection or not by displaying a medium gray checkmark or "x". This was present for 800 ms before the next triad automatically appears. Participants had unlimited time to respond to each triad. The instructions are shown in Figure 3.

1.3 Participants

Participants for this task were restricted to those that had completed the study in Bujack et al. [1] through MTurk and had a significantly above chance accuracy. Consistent with best practices in presenting visualization studies online, participants were asked to self-identify if they had any color vision deficiency and given an online Ishihara plate test.

A total of 755 participants completed this study and each was shown a random subset of 60 triads. Each experimental triad had approximately 120 responses ($M = 119.8, SD = 10.1$). Participants' ages ranged from 18 to 80, with a mean of 39.5. 53.5% identified as male, 45.4% identified as female, and 1.3% identified as other or opted not to answer. Participants were compensated at a level consistent with the median participant time paid at least the federal hourly minimum wage. Participants were treated in accordance with the Participants were treated in accordance with the Los Alamos National Laboratory Human Subject Research Review Board (equivalent to an academic IRB).

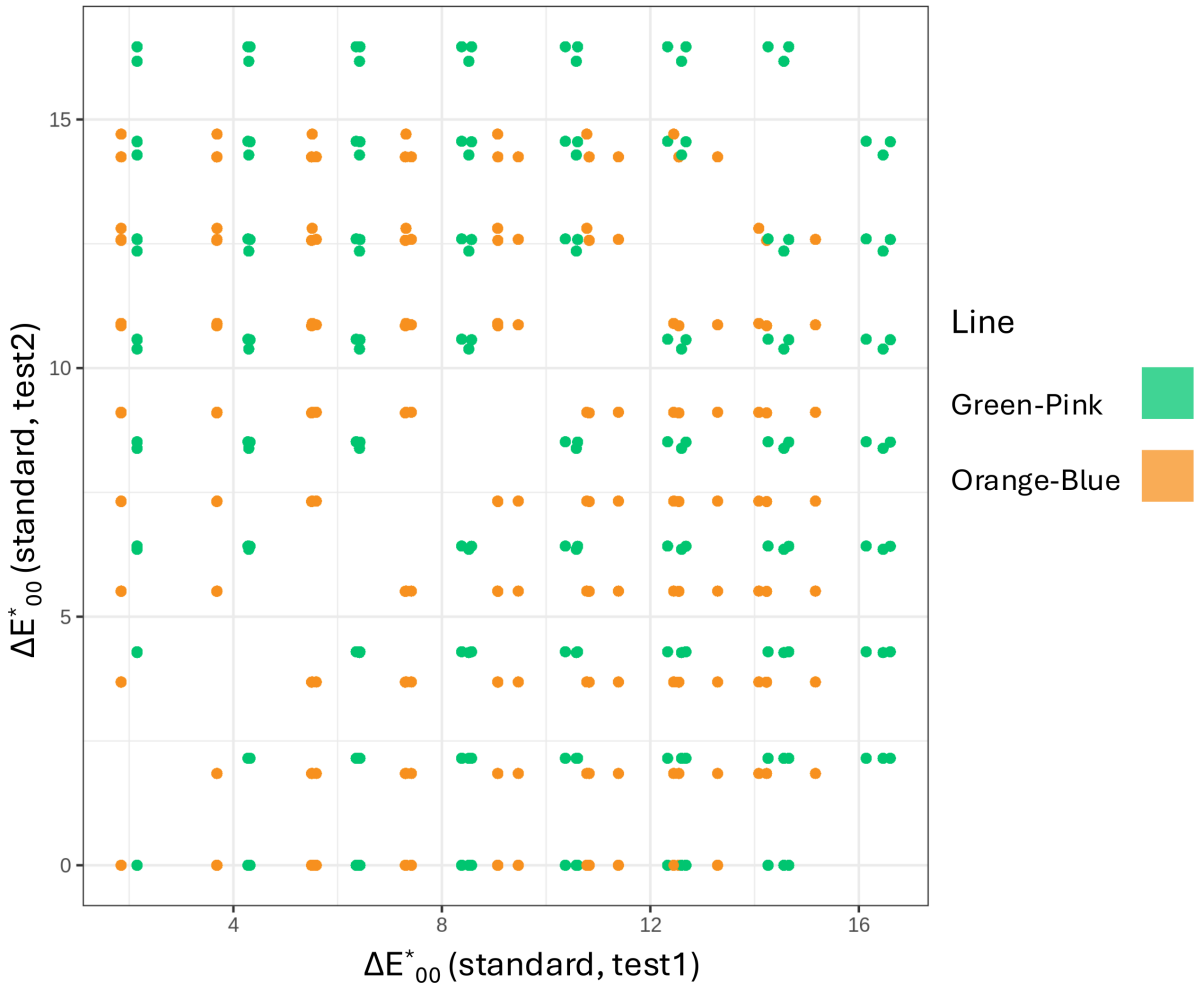


Figure 1: The values, in ΔE^*_{00} units, of the experimental triads. Points are clustered in groups of three due to the three centers along each line.

1.4 Data

The data is required to go through a LANL release process. Once available, it will be added to `https://github.com/lanl/color`.

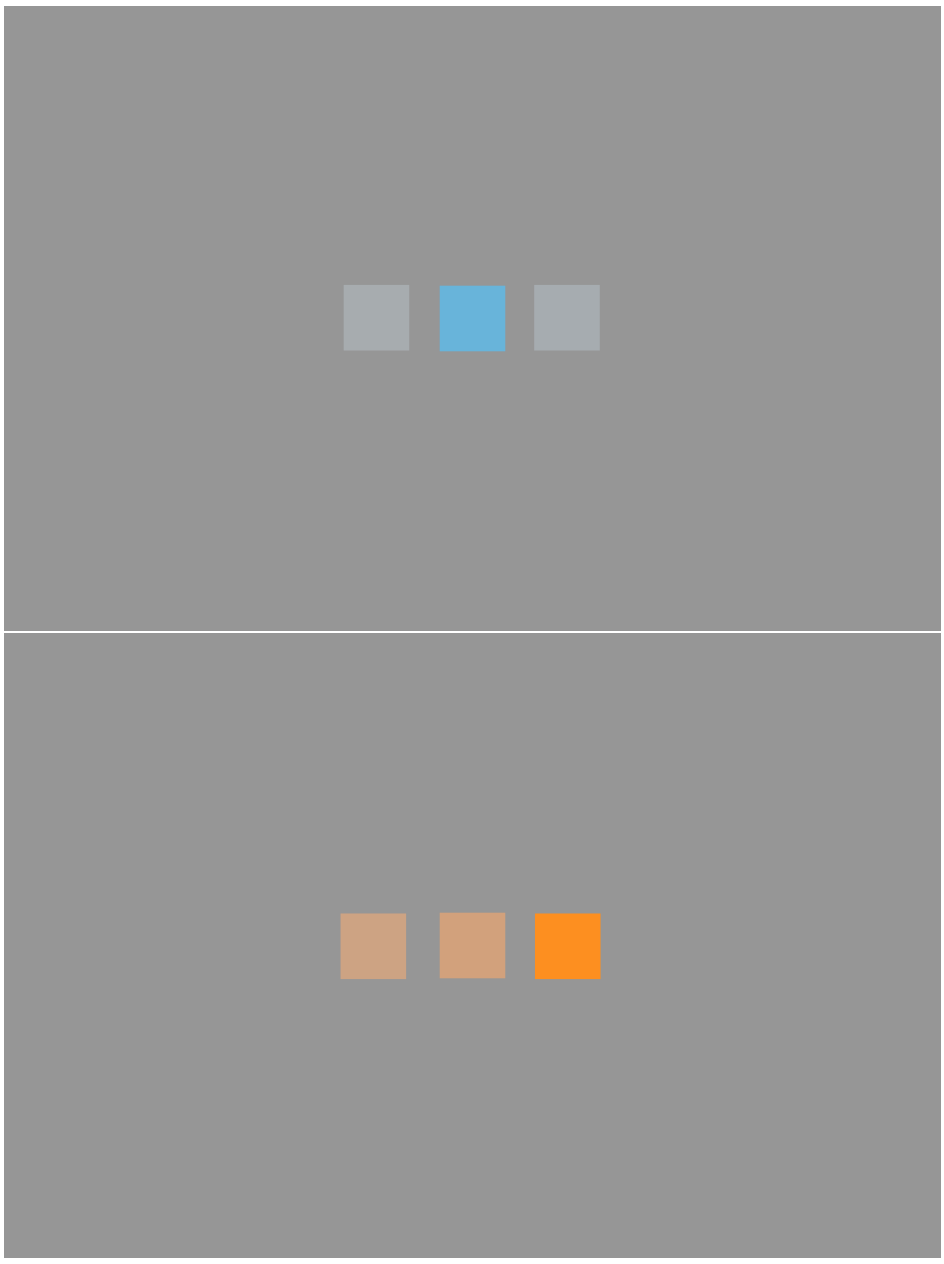


Figure 2: Example stimuli for the blue-orange line.

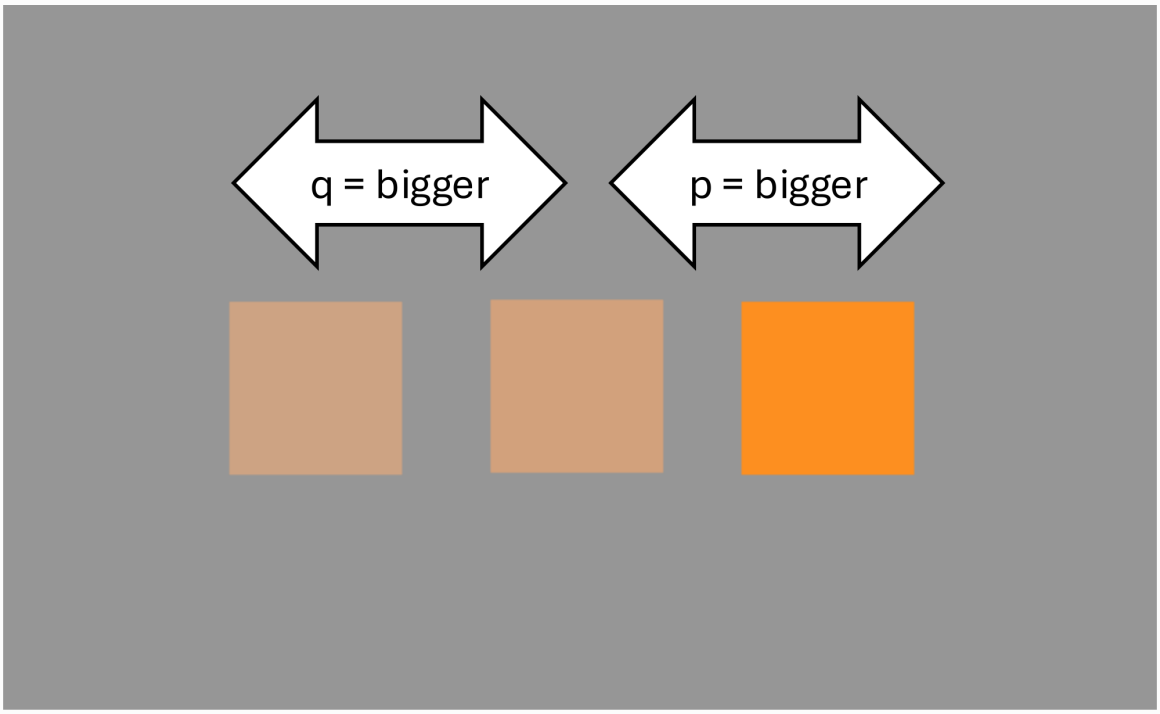
Instructions

Color is often used when scientists display their data. In this study, we are studying the ability of people to accurately compare color differences in an online environment.

You will be shown three color patches as in the image below. The middle patch is the **control patch**. You will use the **q** and **p** keys to respond.

You will need to decide which difference is **greater**.

- If the difference between the middle patch and the **left** patch is **greater** ⇒ press the **q** key
- If the difference between the middle patch and the **right** patch is **greater** ⇒ press the **p** key



We will start with a few training questions and then there will be about 60 patches in the full study. The full study will give you feedback on whether your answer was right or wrong.

Figure 3: Instructions for the study.

Table 1: Triads along the line from Green to Pink.

a^*_{stand}	b^*_{stand}	a^*_{test1}	b^*_{test1}	a^*_{test2}	b^*_{test2}	d_1	d_2
-17.48	8.74	-20.94	10.47	-0.34	0.17	2.15	16.46
-17.48	8.74	-20.94	10.47	-1.81	0.9	2.15	14.56
-17.48	8.74	-20.94	10.47	-3.42	1.71	2.15	12.6
-17.48	8.74	-20.94	10.47	-5.2	2.6	2.15	10.58
-17.48	8.74	-20.94	10.47	-7.17	3.58	2.15	8.52
-17.48	8.74	-20.94	10.47	-9.34	4.67	2.15	6.42
-17.48	8.74	-20.94	10.47	-11.75	5.88	2.15	4.29
-17.48	8.74	-20.94	10.47	-17.48	8.74	2.15	0
-17.48	8.74	-24.9	12.45	-0.34	0.17	4.28	16.46
-17.48	8.74	-24.9	12.45	-1.81	0.9	4.28	14.56
-17.48	8.74	-24.9	12.45	-3.42	1.71	4.28	12.6
-17.48	8.74	-24.9	12.45	-5.2	2.6	4.28	10.58
-17.48	8.74	-24.9	12.45	-7.17	3.58	4.28	8.52
-17.48	8.74	-24.9	12.45	-9.34	4.67	4.28	6.42
-17.48	8.74	-24.9	12.45	-14.45	7.22	4.28	2.15
-17.48	8.74	-24.9	12.45	-17.48	8.74	4.28	0
-17.48	8.74	-29.37	14.68	-0.34	0.17	6.36	16.46
-17.48	8.74	-29.37	14.68	-1.81	0.9	6.36	14.56
-17.48	8.74	-29.37	14.68	-3.42	1.71	6.36	12.6
-17.48	8.74	-29.37	14.68	-5.2	2.6	6.36	10.58
-17.48	8.74	-29.37	14.68	-7.17	3.58	6.36	8.52
-17.48	8.74	-29.37	14.68	-11.75	5.88	6.36	4.29
-17.48	8.74	-29.37	14.68	-14.45	7.22	6.36	2.15
-17.48	8.74	-29.37	14.68	-17.48	8.74	6.36	0
-17.48	8.74	-34.35	17.17	-0.34	0.17	8.38	16.46
-17.48	8.74	-34.35	17.17	-1.81	0.9	8.38	14.56
-17.48	8.74	-34.35	17.17	-3.42	1.71	8.38	12.6
-17.48	8.74	-34.35	17.17	-5.2	2.6	8.38	10.58
-17.48	8.74	-34.35	17.17	-9.34	4.67	8.38	6.42
-17.48	8.74	-34.35	17.17	-11.75	5.88	8.38	4.29
-17.48	8.74	-34.35	17.17	-14.45	7.22	8.38	2.15
-17.48	8.74	-34.35	17.17	-17.48	8.74	8.38	0
-17.48	8.74	-39.85	19.93	-0.34	0.17	10.37	16.46
-17.48	8.74	-39.85	19.93	-1.81	0.9	10.37	14.56
-17.48	8.74	-39.85	19.93	-3.42	1.71	10.37	12.6
-17.48	8.74	-39.85	19.93	-7.17	3.58	10.37	8.52
-17.48	8.74	-39.85	19.93	-9.34	4.67	10.37	6.42
-17.48	8.74	-39.85	19.93	-11.75	5.88	10.37	4.29
-17.48	8.74	-39.85	19.93	-14.45	7.22	10.37	2.15
-17.48	8.74	-39.85	19.93	-17.48	8.74	10.37	0
-17.48	8.74	-45.93	22.96	-0.34	0.17	12.33	16.46
-17.48	8.74	-45.93	22.96	-1.81	0.9	12.33	14.56
-17.48	8.74	-45.93	22.96	-5.2	2.6	12.33	10.58
-17.48	8.74	-45.93	22.96	-7.17	3.58	12.33	8.52
-17.48	8.74	-45.93	22.96	-9.34	4.67	12.33	6.42
-17.48	8.74	-45.93	22.96	-11.75	5.88	12.33	4.29
-17.48	8.74	-45.93	22.96	-14.45	7.22	12.33	2.15
-17.48	8.74	-45.93	22.96	-17.48	8.74	12.33	0
-17.48	8.74	-52.62	26.31	-0.34	0.17	14.26	16.46
-17.48	8.74	-52.62	26.31	-3.42	1.71	14.26	12.6
-17.48	8.74	-52.62	26.31	-5.2	2.6	14.26	10.58

Table 1: Triads along the line from Green to Pink.

a^*_{stand}	b^*_{stand}	a^*_{test1}	b^*_{test1}	a^*_{test2}	b^*_{test2}	d_1	d_2
-17.48	8.74	-52.62	26.31	-7.17	3.58	14.26	8.52
-17.48	8.74	-52.62	26.31	-9.34	4.67	14.26	6.42
-17.48	8.74	-52.62	26.31	-11.75	5.88	14.26	4.29
-17.48	8.74	-52.62	26.31	-14.45	7.22	14.26	2.15
-17.48	8.74	-52.62	26.31	-17.48	8.74	14.26	0
-17.48	8.74	-60	30	-1.81	0.9	16.14	14.56
-17.48	8.74	-60	30	-3.42	1.71	16.14	12.6
-17.48	8.74	-60	30	-5.2	2.6	16.14	10.58
-17.48	8.74	-60	30	-7.17	3.58	16.14	8.52
-17.48	8.74	-60	30	-9.34	4.67	16.14	6.42
-17.48	8.74	-60	30	-11.75	5.88	16.14	4.29
-17.48	8.74	-60	30	-14.45	7.22	16.14	2.15
0.12	-0.06	-1.3	0.65	16.96	-8.48	2.15	16.46
0.12	-0.06	-1.3	0.65	13.99	-6.99	2.15	14.55
0.12	-0.06	-1.3	0.65	11.34	-5.67	2.15	12.59
0.12	-0.06	-1.3	0.65	8.97	-4.49	2.15	10.57
0.12	-0.06	-1.3	0.65	6.83	-3.42	2.15	8.51
0.12	-0.06	-1.3	0.65	4.9	-2.45	2.15	6.42
0.12	-0.06	-1.3	0.65	3.15	-1.57	2.15	4.29
0.12	-0.06	-1.3	0.65	0.12	-0.06	2.15	0
0.12	-0.06	-2.87	1.43	16.96	-8.48	4.32	16.46
0.12	-0.06	-2.87	1.43	13.99	-6.99	4.32	14.55
0.12	-0.06	-2.87	1.43	11.34	-5.67	4.32	12.59
0.12	-0.06	-2.87	1.43	8.97	-4.49	4.32	10.57
0.12	-0.06	-2.87	1.43	6.83	-3.42	4.32	8.51
0.12	-0.06	-2.87	1.43	4.9	-2.45	4.32	6.42
0.12	-0.06	-2.87	1.43	1.56	-0.78	4.32	2.15
0.12	-0.06	-2.87	1.43	0.12	-0.06	4.32	0
0.12	-0.06	-4.59	2.29	16.96	-8.48	6.43	16.46
0.12	-0.06	-4.59	2.29	13.99	-6.99	6.43	14.55
0.12	-0.06	-4.59	2.29	11.34	-5.67	6.43	12.59
0.12	-0.06	-4.59	2.29	8.97	-4.49	6.43	10.57
0.12	-0.06	-4.59	2.29	6.83	-3.42	6.43	8.51
0.12	-0.06	-4.59	2.29	3.15	-1.57	6.43	4.29
0.12	-0.06	-4.59	2.29	1.56	-0.78	6.43	2.15
0.12	-0.06	-4.59	2.29	0.12	-0.06	6.43	0
0.12	-0.06	-6.49	3.24	16.96	-8.48	8.57	16.46
0.12	-0.06	-6.49	3.24	13.99	-6.99	8.57	14.55
0.12	-0.06	-6.49	3.24	11.34	-5.67	8.57	12.59
0.12	-0.06	-6.49	3.24	8.97	-4.49	8.57	10.57
0.12	-0.06	-6.49	3.24	4.9	-2.45	8.57	6.42
0.12	-0.06	-6.49	3.24	3.15	-1.57	8.57	4.29
0.12	-0.06	-6.49	3.24	1.56	-0.78	8.57	2.15
0.12	-0.06	-6.49	3.24	0.12	-0.06	8.57	0
0.12	-0.06	-8.59	4.29	16.96	-8.48	10.61	16.46
0.12	-0.06	-8.59	4.29	13.99	-6.99	10.61	14.55
0.12	-0.06	-8.59	4.29	11.34	-5.67	10.61	12.59
0.12	-0.06	-8.59	4.29	6.83	-3.42	10.61	8.51
0.12	-0.06	-8.59	4.29	4.9	-2.45	10.61	6.42
0.12	-0.06	-8.59	4.29	3.15	-1.57	10.61	4.29
0.12	-0.06	-8.59	4.29	1.56	-0.78	10.61	2.15

Table 1: Triads along the line from Green to Pink.

a^*_{stand}	b^*_{stand}	a^*_{test1}	b^*_{test1}	a^*_{test2}	b^*_{test2}	d_1	d_2
0.12	-0.06	-8.59	4.29	0.12	-0.06	10.61	0
0.12	-0.06	-10.92	5.46	16.96	-8.48	12.68	16.46
0.12	-0.06	-10.92	5.46	13.99	-6.99	12.68	14.55
0.12	-0.06	-10.92	5.46	8.97	-4.49	12.68	10.57
0.12	-0.06	-10.92	5.46	6.83	-3.42	12.68	8.51
0.12	-0.06	-10.92	5.46	4.9	-2.45	12.68	6.42
0.12	-0.06	-10.92	5.46	3.15	-1.57	12.68	4.29
0.12	-0.06	-10.92	5.46	1.56	-0.78	12.68	2.15
0.12	-0.06	-10.92	5.46	0.12	-0.06	12.68	0
0.12	-0.06	-13.51	6.76	16.96	-8.48	14.66	16.46
0.12	-0.06	-13.51	6.76	11.34	-5.67	14.66	12.59
0.12	-0.06	-13.51	6.76	8.97	-4.49	14.66	10.57
0.12	-0.06	-13.51	6.76	6.83	-3.42	14.66	8.51
0.12	-0.06	-13.51	6.76	4.9	-2.45	14.66	6.42
0.12	-0.06	-13.51	6.76	3.15	-1.57	14.66	4.29
0.12	-0.06	-13.51	6.76	1.56	-0.78	14.66	2.15
0.12	-0.06	-13.51	6.76	0.12	-0.06	14.66	0
0.12	-0.06	-16.43	8.21	13.99	-6.99	16.6	14.55
0.12	-0.06	-16.43	8.21	11.34	-5.67	16.6	12.59
0.12	-0.06	-16.43	8.21	8.97	-4.49	16.6	10.57
0.12	-0.06	-16.43	8.21	6.83	-3.42	16.6	8.51
0.12	-0.06	-16.43	8.21	4.9	-2.45	16.6	6.42
0.12	-0.06	-16.43	8.21	3.15	-1.57	16.6	4.29
0.12	-0.06	-16.43	8.21	1.56	-0.78	16.6	2.15
18.04	-9.02	14.94	-7.47	61.33	-30.67	2.15	16.17
18.04	-9.02	14.94	-7.47	53.83	-26.92	2.15	14.29
18.04	-9.02	14.94	-7.47	47.03	-23.51	2.15	12.35
18.04	-9.02	14.94	-7.47	40.85	-20.42	2.15	10.38
18.04	-9.02	14.94	-7.47	35.25	-17.62	2.15	8.39
18.04	-9.02	14.94	-7.47	30.18	-15.09	2.15	6.35
18.04	-9.02	14.94	-7.47	25.63	-12.81	2.15	4.28
18.04	-9.02	14.94	-7.47	18.04	-9.02	2.15	0
18.04	-9.02	12.19	-6.09	61.33	-30.67	4.29	16.17
18.04	-9.02	12.19	-6.09	53.83	-26.92	4.29	14.29
18.04	-9.02	12.19	-6.09	47.03	-23.51	4.29	12.35
18.04	-9.02	12.19	-6.09	40.85	-20.42	4.29	10.38
18.04	-9.02	12.19	-6.09	35.25	-17.62	4.29	8.39
18.04	-9.02	12.19	-6.09	30.18	-15.09	4.29	6.35
18.04	-9.02	12.19	-6.09	21.58	-10.79	4.29	2.15
18.04	-9.02	12.19	-6.09	18.04	-9.02	4.29	0
18.04	-9.02	9.73	-4.87	61.33	-30.67	6.42	16.17
18.04	-9.02	9.73	-4.87	53.83	-26.92	6.42	14.29
18.04	-9.02	9.73	-4.87	47.03	-23.51	6.42	12.35
18.04	-9.02	9.73	-4.87	40.85	-20.42	6.42	10.38
18.04	-9.02	9.73	-4.87	35.25	-17.62	6.42	8.39
18.04	-9.02	9.73	-4.87	25.63	-12.81	6.42	4.28
18.04	-9.02	9.73	-4.87	21.58	-10.79	6.42	2.15
18.04	-9.02	9.73	-4.87	18.04	-9.02	6.42	0
18.04	-9.02	7.52	-3.76	61.33	-30.67	8.52	16.17
18.04	-9.02	7.52	-3.76	53.83	-26.92	8.52	14.29
18.04	-9.02	7.52	-3.76	47.03	-23.51	8.52	12.35

Table 1: Triads along the line from Green to Pink.

a^*_{stand}	b^*_{stand}	a^*_{test1}	b^*_{test1}	a^*_{test2}	b^*_{test2}	d_1	d_2
18.04	-9.02	7.52	-3.76	40.85	-20.42	8.52	10.38
18.04	-9.02	7.52	-3.76	30.18	-15.09	8.52	6.35
18.04	-9.02	7.52	-3.76	25.63	-12.81	8.52	4.28
18.04	-9.02	7.52	-3.76	21.58	-10.79	8.52	2.15
18.04	-9.02	7.52	-3.76	18.04	-9.02	8.52	0
18.04	-9.02	5.52	-2.76	61.33	-30.67	10.58	16.17
18.04	-9.02	5.52	-2.76	53.83	-26.92	10.58	14.29
18.04	-9.02	5.52	-2.76	47.03	-23.51	10.58	12.35
18.04	-9.02	5.52	-2.76	35.25	-17.62	10.58	8.39
18.04	-9.02	5.52	-2.76	30.18	-15.09	10.58	6.35
18.04	-9.02	5.52	-2.76	25.63	-12.81	10.58	4.28
18.04	-9.02	5.52	-2.76	21.58	-10.79	10.58	2.15
18.04	-9.02	5.52	-2.76	18.04	-9.02	10.58	0
18.04	-9.02	3.71	-1.86	61.33	-30.67	12.6	16.17
18.04	-9.02	3.71	-1.86	53.83	-26.92	12.6	14.29
18.04	-9.02	3.71	-1.86	40.85	-20.42	12.6	10.38
18.04	-9.02	3.71	-1.86	35.25	-17.62	12.6	8.39
18.04	-9.02	3.71	-1.86	30.18	-15.09	12.6	6.35
18.04	-9.02	3.71	-1.86	25.63	-12.81	12.6	4.28
18.04	-9.02	3.71	-1.86	21.58	-10.79	12.6	2.15
18.04	-9.02	3.71	-1.86	18.04	-9.02	12.6	0
18.04	-9.02	2.07	-1.04	61.33	-30.67	14.56	16.17
18.04	-9.02	2.07	-1.04	47.03	-23.51	14.56	12.35
18.04	-9.02	2.07	-1.04	40.85	-20.42	14.56	10.38
18.04	-9.02	2.07	-1.04	35.25	-17.62	14.56	8.39
18.04	-9.02	2.07	-1.04	30.18	-15.09	14.56	6.35
18.04	-9.02	2.07	-1.04	25.63	-12.81	14.56	4.28
18.04	-9.02	2.07	-1.04	21.58	-10.79	14.56	2.15
18.04	-9.02	2.07	-1.04	18.04	-9.02	14.56	0
18.04	-9.02	0.58	-0.29	53.83	-26.92	16.46	14.29
18.04	-9.02	0.58	-0.29	47.03	-23.51	16.46	12.35
18.04	-9.02	0.58	-0.29	40.85	-20.42	16.46	10.38
18.04	-9.02	0.58	-0.29	35.25	-17.62	16.46	8.39
18.04	-9.02	0.58	-0.29	30.18	-15.09	16.46	6.35
18.04	-9.02	0.58	-0.29	25.63	-12.81	16.46	4.28
18.04	-9.02	0.58	-0.29	21.58	-10.79	16.46	2.15

Table 2: Triads along the line from Orange to Blue.

a^*_{stand}	b^*_{stand}	a^*_{test1}	b^*_{test1}	a^*_{test2}	b^*_{test2}	d_1	d_2
-5.67	-11.33	-6.94	-13.88	-5.67	-11.33	1.85	0
-5.67	-11.33	-8.34	-16.67	-5.67	-11.33	3.69	0
-5.67	-11.33	-9.87	-19.74	-5.67	-11.33	5.51	0
-5.67	-11.33	-11.55	-23.11	-5.67	-11.33	7.31	0
-5.67	-11.33	-13.4	-26.8	-5.67	-11.33	9.07	0
-5.67	-11.33	-15.42	-30.84	-5.67	-11.33	10.78	0
-5.67	-11.33	-17.61	-35.23	-5.67	-11.33	12.45	0
1.97	3.94	1.1	2.21	1.97	3.94	1.85	0
1.97	3.94	0.31	0.61	1.97	3.94	3.69	0
1.97	3.94	-0.45	-0.9	1.97	3.94	5.59	0
1.97	3.94	-1.26	-2.51	1.97	3.94	7.41	0
1.97	3.94	-2.14	-4.27	1.97	3.94	9.47	0
1.97	3.94	-3.09	-6.19	1.97	3.94	11.39	0
1.97	3.94	-4.13	-8.27	1.97	3.94	13.29	0
13.05	26.11	11.24	22.47	13.05	26.11	1.85	0
13.05	26.11	9.58	19.16	13.05	26.11	3.68	0
13.05	26.11	8.07	16.14	13.05	26.11	5.5	0
13.05	26.11	6.7	13.4	13.05	26.11	7.3	0
13.05	26.11	5.45	10.89	13.05	26.11	9.08	0
13.05	26.11	4.3	8.6	13.05	26.11	10.83	0
13.05	26.11	3.24	6.49	13.05	26.11	12.55	0
13.05	26.11	9.58	19.16	15.04	30.08	3.68	1.85
13.05	26.11	8.07	16.14	15.04	30.08	5.5	1.85
13.05	26.11	6.7	13.4	15.04	30.08	7.3	1.85
13.05	26.11	5.45	10.89	15.04	30.08	9.08	1.85
13.05	26.11	4.3	8.6	15.04	30.08	10.83	1.85
13.05	26.11	3.24	6.49	15.04	30.08	12.55	1.85
13.05	26.11	2.28	4.55	15.04	30.08	14.23	1.85
1.97	3.94	0.31	0.61	2.91	5.82	3.69	1.85
1.97	3.94	-0.45	-0.9	2.91	5.82	5.59	1.85
1.97	3.94	-1.26	-2.51	2.91	5.82	7.41	1.85
1.97	3.94	-2.14	-4.27	2.91	5.82	9.47	1.85
1.97	3.94	-3.09	-6.19	2.91	5.82	11.39	1.85
1.97	3.94	-4.13	-8.27	2.91	5.82	13.29	1.85
1.97	3.94	-5.27	-10.53	2.91	5.82	15.17	1.85
-5.67	-11.33	-8.34	-16.67	-4.5	-9	3.69	1.85
-5.67	-11.33	-9.87	-19.74	-4.5	-9	5.51	1.85
-5.67	-11.33	-11.55	-23.11	-4.5	-9	7.31	1.85
-5.67	-11.33	-13.4	-26.8	-4.5	-9	9.07	1.85
-5.67	-11.33	-15.42	-30.84	-4.5	-9	10.78	1.85
-5.67	-11.33	-17.61	-35.23	-4.5	-9	12.45	1.85
-5.67	-11.33	-20	-40	-4.5	-9	14.08	1.85
13.05	26.11	11.24	22.47	17.2	34.4	1.85	3.68
13.05	26.11	8.07	16.14	17.2	34.4	5.5	3.68
13.05	26.11	6.7	13.4	17.2	34.4	7.3	3.68
13.05	26.11	5.45	10.89	17.2	34.4	9.08	3.68
13.05	26.11	4.3	8.6	17.2	34.4	10.83	3.68
13.05	26.11	3.24	6.49	17.2	34.4	12.55	3.68
13.05	26.11	2.28	4.55	17.2	34.4	14.23	3.68
1.97	3.94	1.1	2.21	3.94	7.87	1.85	3.69
1.97	3.94	-0.45	-0.9	3.94	7.87	5.59	3.69

Table 2: Triads along the line from Orange to Blue.

a^*_{stand}	b^*_{stand}	a^*_{test1}	b^*_{test1}	a^*_{test2}	b^*_{test2}	d_1	d_2
1.97	3.94	-1.26	-2.51	3.94	7.87	7.41	3.69
1.97	3.94	-2.14	-4.27	3.94	7.87	9.47	3.69
1.97	3.94	-3.09	-6.19	3.94	7.87	11.39	3.69
1.97	3.94	-4.13	-8.27	3.94	7.87	13.29	3.69
1.97	3.94	-5.27	-10.53	3.94	7.87	15.17	3.69
-5.67	-11.33	-6.94	-13.88	-3.43	-6.86	1.85	3.69
-5.67	-11.33	-9.87	-19.74	-3.43	-6.86	5.51	3.69
-5.67	-11.33	-11.55	-23.11	-3.43	-6.86	7.31	3.69
-5.67	-11.33	-13.4	-26.8	-3.43	-6.86	9.07	3.69
-5.67	-11.33	-15.42	-30.84	-3.43	-6.86	10.78	3.69
-5.67	-11.33	-17.61	-35.23	-3.43	-6.86	12.45	3.69
-5.67	-11.33	-20	-40	-3.43	-6.86	14.08	3.69
13.05	26.11	11.24	22.47	19.55	39.1	1.85	5.51
13.05	26.11	9.58	19.16	19.55	39.1	3.68	5.51
13.05	26.11	6.7	13.4	19.55	39.1	7.3	5.51
13.05	26.11	5.45	10.89	19.55	39.1	9.08	5.51
13.05	26.11	4.3	8.6	19.55	39.1	10.83	5.51
13.05	26.11	3.24	6.49	19.55	39.1	12.55	5.51
13.05	26.11	2.28	4.55	19.55	39.1	14.23	5.51
1.97	3.94	1.1	2.21	5.05	10.1	1.85	5.51
1.97	3.94	0.31	0.61	5.05	10.1	3.69	5.51
1.97	3.94	-1.26	-2.51	5.05	10.1	7.41	5.51
1.97	3.94	-2.14	-4.27	5.05	10.1	9.47	5.51
1.97	3.94	-3.09	-6.19	5.05	10.1	11.39	5.51
1.97	3.94	-4.13	-8.27	5.05	10.1	13.29	5.51
1.97	3.94	-5.27	-10.53	5.05	10.1	15.17	5.51
-5.67	-11.33	-6.94	-13.88	-2.45	-4.89	1.85	5.51
-5.67	-11.33	-8.34	-16.67	-2.45	-4.89	3.69	5.51
-5.67	-11.33	-11.55	-23.11	-2.45	-4.89	7.31	5.51
-5.67	-11.33	-13.4	-26.8	-2.45	-4.89	9.07	5.51
-5.67	-11.33	-15.42	-30.84	-2.45	-4.89	10.78	5.51
-5.67	-11.33	-17.61	-35.23	-2.45	-4.89	12.45	5.51
-5.67	-11.33	-20	-40	-2.45	-4.89	14.08	5.51
13.05	26.11	11.24	22.47	22.11	44.21	1.85	7.32
13.05	26.11	9.58	19.16	22.11	44.21	3.68	7.32
13.05	26.11	8.07	16.14	22.11	44.21	5.5	7.32
13.05	26.11	5.45	10.89	22.11	44.21	9.08	7.32
13.05	26.11	4.3	8.6	22.11	44.21	10.83	7.32
13.05	26.11	3.24	6.49	22.11	44.21	12.55	7.32
13.05	26.11	2.28	4.55	22.11	44.21	14.23	7.32
-5.67	-11.33	-6.94	-13.88	-1.54	-3.08	1.85	7.32
-5.67	-11.33	-8.34	-16.67	-1.54	-3.08	3.69	7.32
-5.67	-11.33	-9.87	-19.74	-1.54	-3.08	5.51	7.32
-5.67	-11.33	-13.4	-26.8	-1.54	-3.08	9.07	7.32
-5.67	-11.33	-15.42	-30.84	-1.54	-3.08	10.78	7.32
-5.67	-11.33	-17.61	-35.23	-1.54	-3.08	12.45	7.32
-5.67	-11.33	-20	-40	-1.54	-3.08	14.08	7.32
1.97	3.94	1.1	2.21	6.27	12.54	1.85	7.32
1.97	3.94	0.31	0.61	6.27	12.54	3.69	7.32
1.97	3.94	-0.45	-0.9	6.27	12.54	5.59	7.32
1.97	3.94	-2.14	-4.27	6.27	12.54	9.47	7.32

Table 2: Triads along the line from Orange to Blue.

a^*_{stand}	b^*_{stand}	a^*_{test1}	b^*_{test1}	a^*_{test2}	b^*_{test2}	d_1	d_2
1.97	3.94	-3.09	-6.19	6.27	12.54	11.39	7.32
1.97	3.94	-4.13	-8.27	6.27	12.54	13.29	7.32
1.97	3.94	-5.27	-10.53	6.27	12.54	15.17	7.32
13.05	26.11	11.24	22.47	24.88	49.77	1.85	9.1
13.05	26.11	9.58	19.16	24.88	49.77	3.68	9.1
13.05	26.11	8.07	16.14	24.88	49.77	5.5	9.1
13.05	26.11	6.7	13.4	24.88	49.77	7.3	9.1
13.05	26.11	4.3	8.6	24.88	49.77	10.83	9.1
13.05	26.11	3.24	6.49	24.88	49.77	12.55	9.1
13.05	26.11	2.28	4.55	24.88	49.77	14.23	9.1
-5.67	-11.33	-6.94	-13.88	-0.71	-1.42	1.85	9.11
-5.67	-11.33	-8.34	-16.67	-0.71	-1.42	3.69	9.11
-5.67	-11.33	-9.87	-19.74	-0.71	-1.42	5.51	9.11
-5.67	-11.33	-11.55	-23.11	-0.71	-1.42	7.31	9.11
-5.67	-11.33	-15.42	-30.84	-0.71	-1.42	10.78	9.11
-5.67	-11.33	-17.61	-35.23	-0.71	-1.42	12.45	9.11
-5.67	-11.33	-20	-40	-0.71	-1.42	14.08	9.11
1.97	3.94	1.1	2.21	7.6	15.2	1.85	9.11
1.97	3.94	0.31	0.61	7.6	15.2	3.69	9.11
1.97	3.94	-0.45	-0.9	7.6	15.2	5.59	9.11
1.97	3.94	-1.26	-2.51	7.6	15.2	7.41	9.11
1.97	3.94	-3.09	-6.19	7.6	15.2	11.39	9.11
1.97	3.94	-4.13	-8.27	7.6	15.2	13.29	9.11
1.97	3.94	-5.27	-10.53	7.6	15.2	15.17	9.11
13.05	26.11	11.24	22.47	27.9	55.8	1.85	10.85
13.05	26.11	9.58	19.16	27.9	55.8	3.68	10.85
13.05	26.11	8.07	16.14	27.9	55.8	5.5	10.85
13.05	26.11	6.7	13.4	27.9	55.8	7.3	10.85
13.05	26.11	5.45	10.89	27.9	55.8	9.08	10.85
13.05	26.11	3.24	6.49	27.9	55.8	12.55	10.85
13.05	26.11	2.28	4.55	27.9	55.8	14.23	10.85
1.97	3.94	1.1	2.21	9.06	18.12	1.85	10.87
1.97	3.94	0.31	0.61	9.06	18.12	3.69	10.87
1.97	3.94	-0.45	-0.9	9.06	18.12	5.59	10.87
1.97	3.94	-1.26	-2.51	9.06	18.12	7.41	10.87
1.97	3.94	-2.14	-4.27	9.06	18.12	9.47	10.87
1.97	3.94	-4.13	-8.27	9.06	18.12	13.29	10.87
1.97	3.94	-5.27	-10.53	9.06	18.12	15.17	10.87
-5.67	-11.33	-6.94	-13.88	0.06	0.11	1.85	10.88
-5.67	-11.33	-8.34	-16.67	0.06	0.11	3.69	10.88
-5.67	-11.33	-9.87	-19.74	0.06	0.11	5.51	10.88
-5.67	-11.33	-11.55	-23.11	0.06	0.11	7.31	10.88
-5.67	-11.33	-13.4	-26.8	0.06	0.11	9.07	10.88
-5.67	-11.33	-17.61	-35.23	0.06	0.11	12.45	10.88
-5.67	-11.33	-20	-40	0.06	0.11	14.08	10.88
13.05	26.11	11.24	22.47	31.18	62.36	1.85	12.57
13.05	26.11	9.58	19.16	31.18	62.36	3.68	12.57
13.05	26.11	8.07	16.14	31.18	62.36	5.5	12.57
13.05	26.11	6.7	13.4	31.18	62.36	7.3	12.57
13.05	26.11	5.45	10.89	31.18	62.36	9.08	12.57
13.05	26.11	4.3	8.6	31.18	62.36	10.83	12.57

Table 2: Triads along the line from Orange to Blue.

a^*_{stand}	b^*_{stand}	a^*_{test1}	b^*_{test1}	a^*_{test2}	b^*_{test2}	d_1	d_2
13.05	26.11	2.28	4.55	31.18	62.36	14.23	12.57
1.97	3.94	1.1	2.21	10.67	21.33	1.85	12.59
1.97	3.94	0.31	0.61	10.67	21.33	3.69	12.59
1.97	3.94	-0.45	-0.9	10.67	21.33	5.59	12.59
1.97	3.94	-1.26	-2.51	10.67	21.33	7.41	12.59
1.97	3.94	-2.14	-4.27	10.67	21.33	9.47	12.59
1.97	3.94	-3.09	-6.19	10.67	21.33	11.39	12.59
1.97	3.94	-5.27	-10.53	10.67	21.33	15.17	12.59
-5.67	-11.33	-6.94	-13.88	0.83	1.66	1.85	12.81
-5.67	-11.33	-8.34	-16.67	0.83	1.66	3.69	12.81
-5.67	-11.33	-9.87	-19.74	0.83	1.66	5.51	12.81
-5.67	-11.33	-11.55	-23.11	0.83	1.66	7.31	12.81
-5.67	-11.33	-13.4	-26.8	0.83	1.66	9.07	12.81
-5.67	-11.33	-15.42	-30.84	0.83	1.66	10.78	12.81
-5.67	-11.33	-20	-40	0.83	1.66	14.08	12.81
13.05	26.11	11.24	22.47	34.74	69.49	1.85	14.25
13.05	26.11	9.58	19.16	34.74	69.49	3.68	14.25
13.05	26.11	8.07	16.14	34.74	69.49	5.5	14.25
13.05	26.11	6.7	13.4	34.74	69.49	7.3	14.25
13.05	26.11	5.45	10.89	34.74	69.49	9.08	14.25
13.05	26.11	4.3	8.6	34.74	69.49	10.83	14.25
13.05	26.11	3.24	6.49	34.74	69.49	12.55	14.25
1.97	3.94	1.1	2.21	12.43	24.86	1.85	14.25
1.97	3.94	0.31	0.61	12.43	24.86	3.69	14.25
1.97	3.94	-0.45	-0.9	12.43	24.86	5.59	14.25
1.97	3.94	-1.26	-2.51	12.43	24.86	7.41	14.25
1.97	3.94	-2.14	-4.27	12.43	24.86	9.47	14.25
1.97	3.94	-3.09	-6.19	12.43	24.86	11.39	14.25
1.97	3.94	-4.13	-8.27	12.43	24.86	13.29	14.25
-5.67	-11.33	-6.94	-13.88	1.67	3.35	1.85	14.7
-5.67	-11.33	-8.34	-16.67	1.67	3.35	3.69	14.7
-5.67	-11.33	-9.87	-19.74	1.67	3.35	5.51	14.7
-5.67	-11.33	-11.55	-23.11	1.67	3.35	7.31	14.7
-5.67	-11.33	-13.4	-26.8	1.67	3.35	9.07	14.7
-5.67	-11.33	-15.42	-30.84	1.67	3.35	10.78	14.7
-5.67	-11.33	-17.61	-35.23	1.67	3.35	12.45	14.7

References

[1] Roxana Bujack, Emily Teti, Jonah Miller, Elektra Caffrey, and Terece L Turton. The non-riemannian nature of perceptual color space. *Proceedings of the National Academy of Sciences*, 119(18), 2022.

Released under LA-UR-25-23752