Purple Is Not in the Spectrum: Mixtures Lie on a Straight Line While the Monochromatic Locus Curves

— mixtures of the two spectral ends lie on the segment joining them, yet the nearest monochromatic light to its midpoint is still 0.265513 away, and the spectral locus bends away by as much as 0.556555 — the separator is whether one asks if a colour can be mixed or if a wavelength exists — [Paper 832]

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— From thinking to syncing. —

Abstract

A rainbow shows violet, yet part of what is seen as "purple" is nowhere in the spectrum.This paper counts, in a model with three receptors placed as peaks, that mixtures lie on a straight line while the monochromatic locus curves.No new theorem or law is claimed. First, the chromaticities of monochromatic light form a curve——over 301 points from 400 to 700 nm, the ends are $(0.991818, 0.005277)$ and $(0.000000, 0.029312)$ (Section 2). **Second, and this is the core. Mixtures lie on the segment joining those ends——at proportions 0.25, 0.5 and 0.75 the distance from the segment is of order 10^{-18}** (Section 3). **Third, no monochromatic light lies on that segment——the nearest to the midpoint $(0.495909, 0.017295)$ is at 471 nm and still 0.265513 away** (Section 3). **Fourth, the locus curves far from the segment——by as much as 0.556555** (Section 2). **Fifth, so colour and wavelength are not in one-to-one correspondence——some colours exist only as mixtures, and they make up the line of purples** (Section 4). **Sixth, the separator is whether one asks if a colour can be mixed or if a wavelength exists——"does that colour exist?" points at two different questions** (Section 4). **Keywords**: line of purples, chromaticity, mixture, monochromatic light, spectral locus, model.

Scope of this paper (scope note): **No new theorem or law is claimed——that mixtures lie on straight lines in a chromaticity diagram, that the monochromatic locus is convex, and that the segment joining its ends is called the line of purples, are all known.This is a model——three receptors are placed as Gaussian peaks at 440, 540 and 565 nm; these are not the colour-matching functions.No real values of vision are claimed——the positions and widths of the peaks, and the coordinates themselves, are values of the model.Appearance is not discussed——colour names, language, culture, adaptation and contrast are not the subject.No colour space is designed——choices of coordinates and uniform colour spaces are not entered.Variation in colour vision is not treated——observers with different receptor types are not considered.Relation to earlier papers**: **Paper 163 showed that "a good code exists" and "here is a good code" are different sentences——this paper stands beside it: "that colour exists" and "that wavelength exists" are likewise different.Paper 300 showed that whether two things share a root is decidable——being mixable and being monochromatic are distinct roots.**What is added is **confirming to within 10^{-18} that mixtures lie on the segment**, **measuring the nearest monochromatic light to the midpoint at 471 nm and 0.265513**, **measuring the locus departing by 0.556555**, and **placing the separator on mixture versus monochromatic light**.

1. Notation and the Question

Setting: **three receptor responses are placed as Gaussian peaks in wavelength, at 440, 540 and 565 nm.**

$$r_i(\lambda) = \exp\left(-\tfrac{1}{2}\left(\frac{\lambda-\mu_i}{\sigma_i}\right)^2\right), \qquad (x,y) = \left(\frac{r_1}{r_1+r_2+r_3}, \frac{r_2}{r_1+r_2+r_3}\right)$$

The normalised pair is the chromaticity.Mixing lights adds the responses.

Question: **are there colours that can only be mixed?**

2. The Monochromatic Locus

Computation 2.1: **301 points from 400 to 700 nm at 1 nm steps were converted to chromaticities.**

wavelength	chromaticity
400 nm	$(0.991818, 0.005277)$
700 nm	$(0.000000, 0.029312)$

> **Observation 2.2**
>
> **the locus curves.Its points depart from the segment joining the ends by as much as 0.556555——the receptor peaks overlap while sitting apart, so moving the wavelength sweeps the coordinates along an arc.**

3. Mixtures, and the Line of Purples

Computation 3.1: **lights at 400 and 700 nm were mixed in several proportions and the distance from the segment measured.**

share of 400 nm	chromaticity	distance from the segment
0.25	$(0.915950, 0.007116)$	8.674×10^{-18}
0.5	$(0.965170, 0.005923)$	2.602×10^{-18}
0.75	$(0.982773, 0.005497)$	3.469×10^{-18}

> **Observation 3.2**
>
> **this is the core. Mixtures lie on the straight line.The distances are of order 10^{-18}, within the rounding of the computation——because responses add and the chromaticity is their normalisation.**

Computation 3.3: **the monochromatic light nearest the midpoint $(0.495909, 0.017295)$ was sought.**

measured	value
nearest monochromatic light	471 nm
its distance	0.265513
distance of a mixture	order 10^{-18}

Observation 3.4

no monochromatic light lies on the line.Even the nearest is 0.265513 away, orders apart from the mixtures——colours on this line can only be made by mixing.

4. The Separator

Observation 4.1

the separator is whether one asks if a colour can be mixed or if a wavelength exists.Colours on the line of purples can be mixed and do not exist as wavelengths——“does that colour exist?” points at two questions.

Observation 4.2

so colour and wavelength are not in one-to-one correspondence.A wavelength fixes a colour, but a colour does not fix a wavelength——because some colours exist only as mixtures.

Observation 4.3

placed beside Papers 163 and 300.Paper 163 showed that “a good code exists” and “here is a good code” differ——“that colour exists” and “that wavelength exists” differ in the same way.Paper 300 showed that sharing a root is decidable——being mixable and being monochromatic are distinct roots.

Observation 4.4

what is not said.Real colour-matching functions, colour names and culture, colour-space design and variation in colour vision are not treated——what is shown is that the difference between a line and a curve separates “can be made” from “exists as a wavelength”.

5. Census and Closing

1. **400 nm at $(0.991818, 0.005277)$** (Computation 2.1): **the short end.**

2. **700 nm at $(0.000000, 0.029312)$** (Computation 2.1): **the long end.**
3. **locus departs by 0.556555** (Observation 2.2): **it curves.**
4. **mixtures on the line** (Computation 3.1): **the core; order 10^{-18}.**
5. **midpoint $(0.495909, 0.017295)$** (Computation 3.3): **middle of the purples.**
6. **nearest monochromatic at 471 nm** (Computation 3.3): **not an end.**
7. **its distance 0.265513** (Computation 3.3): **orders apart.**
8. **none on the line** (Observation 3.4): **mixing only.**
9. **not one to one** (Observation 4.2): **only one direction holds.**
10. **mixture or monochromatic** (Observation 4.1): **the separator; Papers 163, 300.**

Closing: **Purple is not in the spectrum: mixtures lie on a straight line while the monochromatic locus curves.With three receptors placed as peaks, 301 points from 400 to 700 nm end at $(0.991818, 0.005277)$ and $(0.000000, 0.029312)$, and the locus departs from the segment joining them by as much as 0.556555——the peaks overlap while sitting apart.Mixtures of the two ends lie on that segment to within 10^{-18} whatever the proportion, while the nearest monochromatic light to its midpoint $(0.495909, 0.017295)$ is at 471 nm and still 0.265513 away——because responses add.Colour and wavelength are therefore not in one-to-one correspondence, and the separator is whether one asks if a colour can be mixed or if a wavelength exists.Placed among the earlier papers——standing beside Paper 163's "exists" against "here it is", and keeping Paper 300's discipline between the two senses of existing.To be honest——these are coordinates of a model built from Gaussian peaks, not real colour-matching functions.**

References

1. Yamagishi, Y. (2026). *"A Good Code Exists" and "Here Is a Good Code" Are Different Sentences* [Paper 163]. Zenodo. 10.5281/zenodo.22092677
2. Yamagishi, Y. (2026). *The Three Hundredth Census: Whether Two Things Share a Root Is Decidable* [Paper 300]. Zenodo. 10.5281/zenodo.22171914

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