"OLO, a Color Never Seen Before . . .

Science or Science Fiction ?"

[summary – August 2025]

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My attention was recently drawn to an article published in *Le Monde – Sciences, Biomedical Realities* on April 24, 2025, titled "***A Never-Seen Color Revealed by a LASER Beam in the Eye***." [1] This article summarized original research made by an American scientists group [2] from the Universities of Berkeley and Seattle, published in *Science Advances – Cognitive Neuroscience* on April 18, 2025. The original title is, let's say, less provocative. They call this (super)color "***olo***."
Various journals —scientific and otherwise— and media outlets have followed, often without much precision or explanation, leaving the public intrigued and perhaps deliberately maintaining a certain air of mystery.
Initially, I was skeptical of the somewhat sensational headline.
"***A color never seen before***" : what does that really mean ? Was a new color *created*, or did it already exist but had never been perceived ? If so, why and could we "create" others ?
A follow-up question : Can there be visible colors that humans have never seen, ***beyond the human gamut*** — the color space of the human eye [3] ? How was the color "***olo***" seen… by at least five people so far ?
These are just some of the many questions this claim legitimately raises.

Preliminary Notes [4]

When discussing photocolorimetry, it's crucial to remember that ***color is not a physical quantity*** like mass or energy, it cannot be measured or represented by a number with a unit. Color is a ***sensation created by our brain***, based on photon information received by the photosensitive cells lining our retinas : rods and cones.

- ***Rods*** are mainly sensitive to brightness and are responsible for ***scotopic (night) vision***.
- ***Cones*** are sensitive to color and responsible for ***photopic (daylight) vision***.
  There are three types *:* ***L, M, and S***, with peak sensitivities in red, green, and blue respectively.

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1. Marc Gozlan, *Une couleur jamais vue, révélée par un faisceau laser dans l'œil*, Le Monde – 28 avril 2025, https://www.lemonde.fr/realites-biomedicales/article/2025/04/24/une-couleur-jamais-vue-revelee-par-un-faisceau-laser-dans-l-il_6599685_6579630.html ; Louise Le Ridant, *« Olo » : une nouvelle couleur jamais vue révélée par la stimulation de la rétine*, Pour la Science, 573 (juillet 2025), https://www.pourlascience.fr/sd/neurosciences/olo-une-nouvelle-couleur-jamais-vue-revelee-par-la-stimulation-de-la-retine-27799.php ; *Une nouvelle couleur indécelable à l'œil humain*, Sciences et Avenir, 940 (juin 2025), 19 ; Elise Morel (Le Journal du Dimanche), *Qu'est-ce que la nouvelle couleur « olo » ?,* https://www.lejdd.fr/Societe/quest-ce-que-la-nouvelle-couleur-olo-157526 ; Axel Juin (RTL), *Olo : quelle est cette "nouvelle couleur" mise au point par la science ?,* https://www.rtl.fr/actu/international/olo-quelle-est-cette-nouvelle-couleur-mise-au-point-par-la-science-7900497306 **;** *Science,* https://briefstory.io/posts/des-scientifiques-ont-decouvert-une-nouvelle-couleur--olo-- ;
2. James Fong, Hannah K. Doyle, Congli *Wang*, Alexandra E. Boehm, Sofie R. Herbeck, Vimal Prabhu Pandiyan, Brian P. Schmidt, Pavan Tiruveedhula, John E. Vanston, William S. Tuten, Ramkumar Sabesan, Austin Roorda, Ren Ng, *Novel color via* stimulation *of individual photoreceptors at population scale*, Sci. Adv. **11**, eadu1052 (18 April 2025), 11 pages
3. https://fr.wikipedia.org/wiki/Gamut
4. Yvon Renotte, *La couleur, une question simple ?* https://hdl.handle.net/2268/258726 ; *Il n'y a pas de couleur sans lumière . . . mail il y a couleurs . . . et couleurs*, Document pédagogique (2024), 17 pages ; PromOptica NewsLetter 7, novembre 2024, 3 pages ; https://hdl.handle.net/2268/323862

Their sensitivity spectra overlap and form the basis of ***trichromatic theory***, suspected by Newton in the 18th century, initiated by Young, formalized by Maxwell, and popularized by Helmholtz in the 19th century.

To quantify a color, we typically use:

- One ***photometric term*** for brightness (illuminance or luminance)
- Two ***chrominance terms*** for hue

This representation stems from ***Grassmann's laws of color mixing***, and was standardized by the ***CIE* (International Commission on Illumination)** in the early 20th century with the ***RGB-1931 system***, later replaced by the more practical ***XYZ-1931 system***.

Another approach, more physiological, is the ***LMS system***, which measures cone-specific responses. Though often confused with RGB or XYZ, LMS is a conceptually distinct system. Conversion between these systems requires complex transformation matrices, which the CIE provides.

Comments on the Original Study

The original article reveals that the researchers had an other goal. They wanted to test whether the ***human brain reacts differently*** to monochromatic green light when :

- It stimulates ***all three cone types simultaneously***, versus
- It is ***targeted specifically*** *to only* ***M-cones*** (green-sensitive)

Five volunteers (including three co-authors) underwent both types of stimulation using a sophisticated platform called ***Oz***, designed to selectively illuminate M-cones. The same green light was then used to stimulate all cones simultaneously.

Oz uses a ***scanning ophthalmoscope*** combining ***OCT* (Optical Coherence Tomography)** and **Adaptive Optics**, enhanced with precision components like LASERs and controllable light sources.

The researchers determined the ***LMS coordinates of "olo"*** using a rigorous color-matching protocol and targeted cone stimulation. The perceived color was described as :

- A ***highly saturated blue-green hue***,
- "*Beyond anything we've ever known*," according to participants, including Prof. Ng from UC Berkeley.

Although generated using a ***543 nm green laser***, "***olo***" is not defined by its wavelength but by its ***exclusive stimulation of M-cones***. The corresponding monochromatic wavelengths (501–512 nm) resemble ***oversaturated turquoise***.

"***Olo***" is a ***spatial metametric color*** [5]***, outside the human gamut***, created by ***"hacking" the retina***, not by natural light. ***It remains invisible without technological aid***. If the stimulation is disrupted (e.g., by jittering the beam to hit neighboring cones), the color collapses back to the laser's natural green.

Implications and Future Directions

The Oz platform opens ***astonishing possibilities*** but also ***technical challenges*** and many questions :

- It could revolutionize ***vision science and neuroscience***, offering a new experimental platform.
- It may help explore ***brain plasticity*** in the visual system and uncover ***new dimensions of color perception***.
- It might even aid in ***restoring color vision in colorblind individuals***, or enable ***tetrachromatic vision*** (adding a fourth cone type, as seen in many birds eyes).

Criticism and Caution

Naturally, such a bold claim has drawn criticism. While many critiques are valid, ***no peer-reviewed journal has yet published a formal rebuttal.*** Most critiques circulate as anonymous expert reports or informal comments on post-publication platforms.

5. Günter W. Wyszecki, *Evaluation of metameric colors*, J. Opt. Soc. Am., 48 (7) (1958), 451–454 ; Correlate for brightness in terms of CIE chromaticity coordinates and luminous reflectance, *J. Opt. Soc. Am.*, **57** (2) (1967), 254–257

Final Afterthoughts

Given the experimental results, it seems the brain does react differently depending on whether light stimulation is global or selective. This invites further experimentation. Could we discover or create ***entirely new color systems*** ? Are there ***unexplored color spaces*** ?

But… aren't we ***flirting with the boundary between science and science fiction*** ?

Appendices : Origins of the Names

- **"*Olo*"** is a nod to the *LMS* coordinates (0, 1, 0) for green light stimulating M-cones playfully rendered as O, L, O by the research team.
- **"*Oz*"** references *The Wizard of Oz*, set in the Emerald City, bathed in intense green light symbolizing magic, illusion, and a world beyond ordinary reality.

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