Image Filter for a Color Deficient Person

Image Processing | Instructor: Dr. Mihran Tuceryan

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What if ?


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What if ?

Problem Statement

- A color deficient person **cannot distinguish** the difference between some colors.
- Roughly there are around **5% to 8% of men and 0.8% of women** that have some kind of color deficiency or color blindness around the world.
- Out of all the persons diagnosed by color blindness, 90% of them will be suffering from **some kind of red-green** deficiency in which they cannot distinguish red and green color.
- Images that have such **colors and shades can be difficult to view**.

Back ground/Previous Work

- Human color vision works on the responses to the photons in three different types of photoreceptors, which are also called **“cones”.**
- The sensitivities of these cones lie in the **Long (L), Medium (M), and Short (S)** wavelength regions of the light spectrum.
- Color deficiency is frequently characterized by some shifts of one or more cone types that makes the pigments in one type of cone, not sufficiently distinct from the pigments in others.
- **Protanopia** and **Deuteranopia** have difficulty in distinguishing red from green which is commonly detected, while **Tritanopia** has difficulty in discriminating blue from yellow which is a rare.

References

- Information Preserving Color Transformation for Protanopia and Deuteranopia, Jia-Bin Huang, Yu-Cheng Tseng, Se-In Wu, and Sheng-Jyh Wang, Member, IEEE, IEEE SIGNAL PROCESSING LETTERS, VOL. 14, NO. 10, OCTOBER 2007.
- Modifying Images for Color Blind Viewers, William Woods, Electrical Engineering Department, Stanford University, USA.
- “Color-defective vision and computer graphics displays,” By G. Meyer and D. Greenberg, IEEE Computer Graphic Application, vol. 8, no. 5, pp. 28–40, Sep. 1988.

Solution

- This project is about the implementation of different algorithms to simulate and filter an image so that the color deficient person can distinguish between the colors and interpret the information presented by the image.
- Two approaches to the problem.

    1. LMS Daltonization (decrease the intensity of the colors)

    - Is nothing but the mapping of the lost information to wavelengths visible to the viewer, which is Long (Red) and Short (Blue) wavelengths.

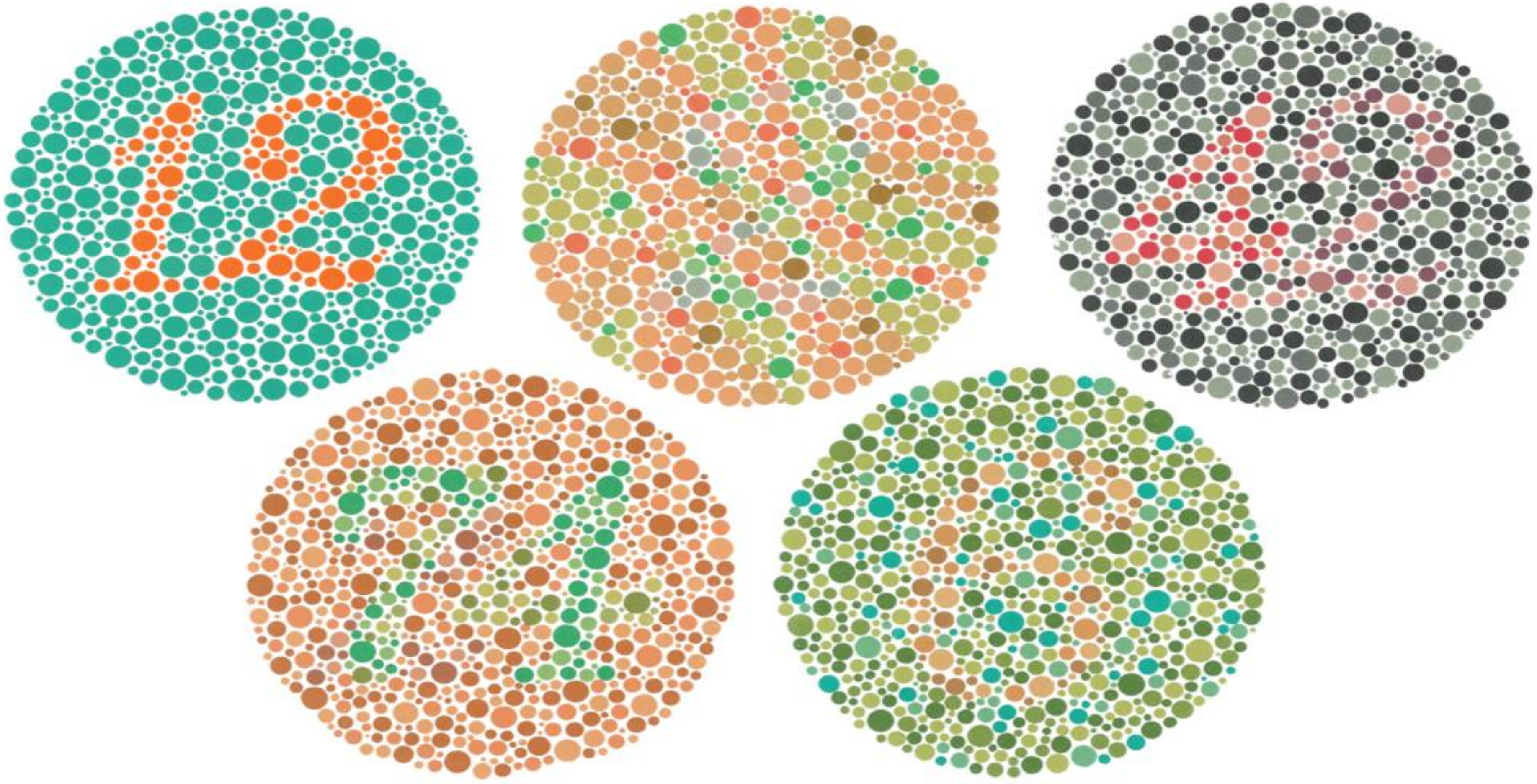
    2. **LAB Color Correction (increase the intensity of the colors)**

    - Here we adjust the L and B color space of the image according to the A's value.

Methods used/Experiments

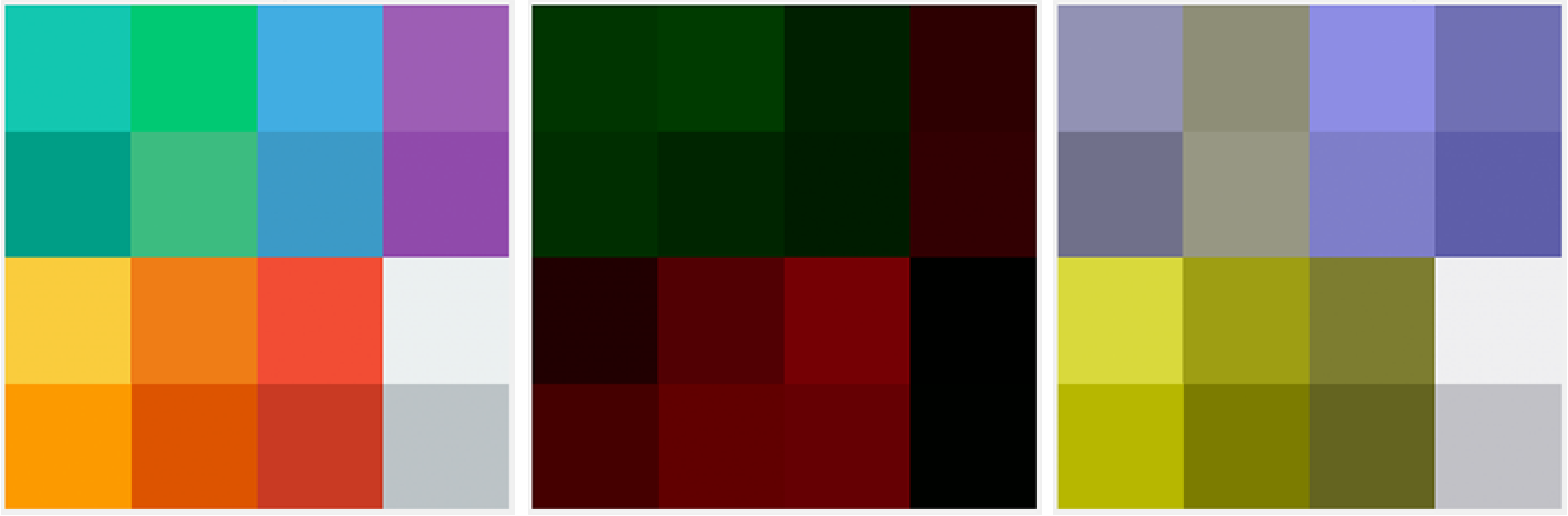
- All the simulation and filters are implemented using MATLAB as it provides much easy and simpler interface for image processing.
- First step is to simulate the color blindness.
- Use the data about the information lost during the simulation to implement **LMS Daltonization** method.
- Implement **LAB Color Correction.**
- Once again simulate the filtered images to see if the outputs are correct and obtain the results.

Before discussing Results let’s take a Color blindness test proposed by Dr. Shinobu Ishihara in 1917!!



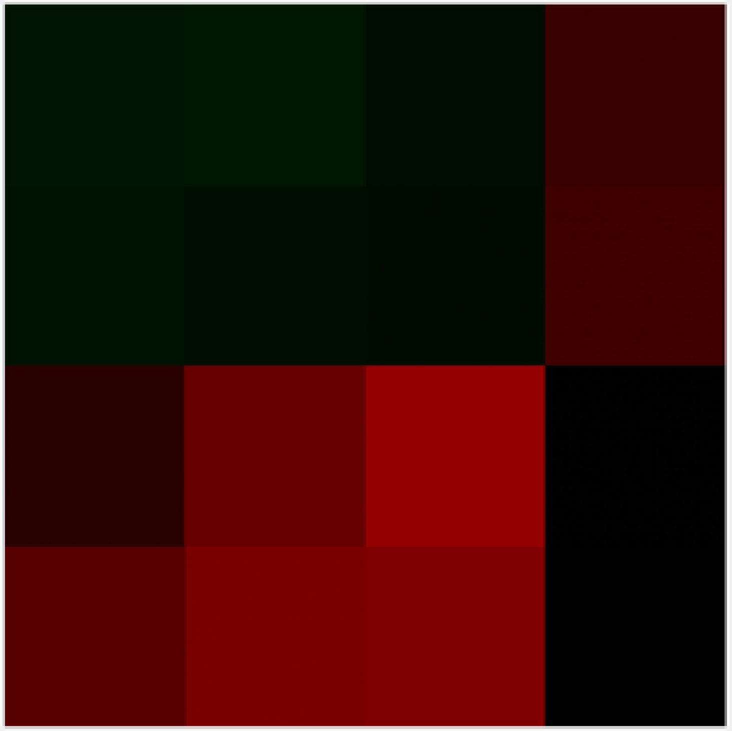
Results

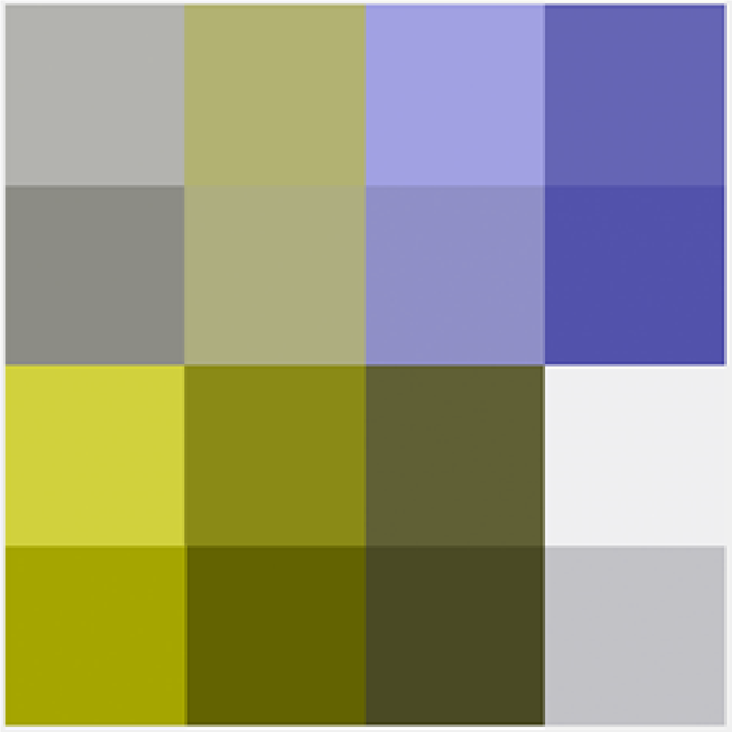
- Deuteranopia Simulation:



Results (Cont.)

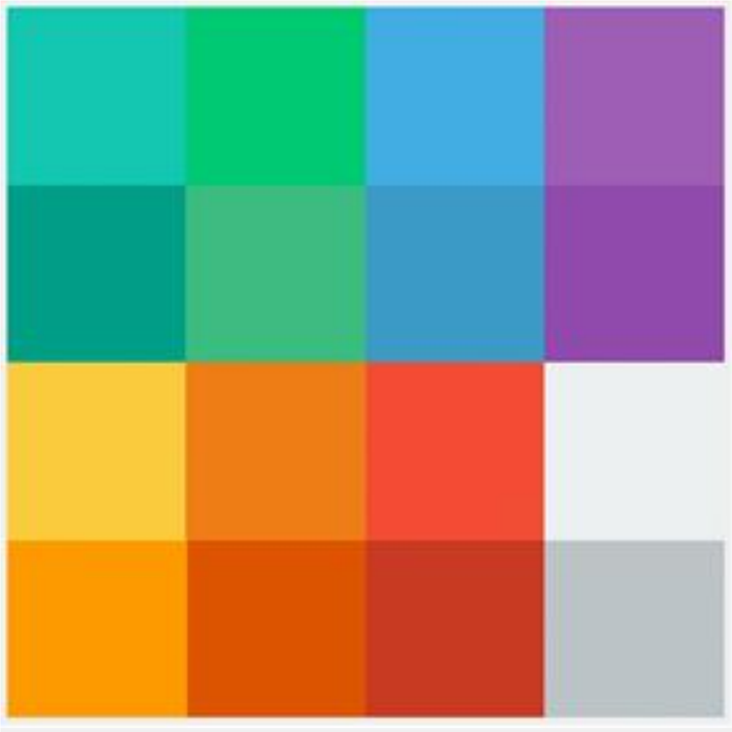
- Protanopia Simulation:

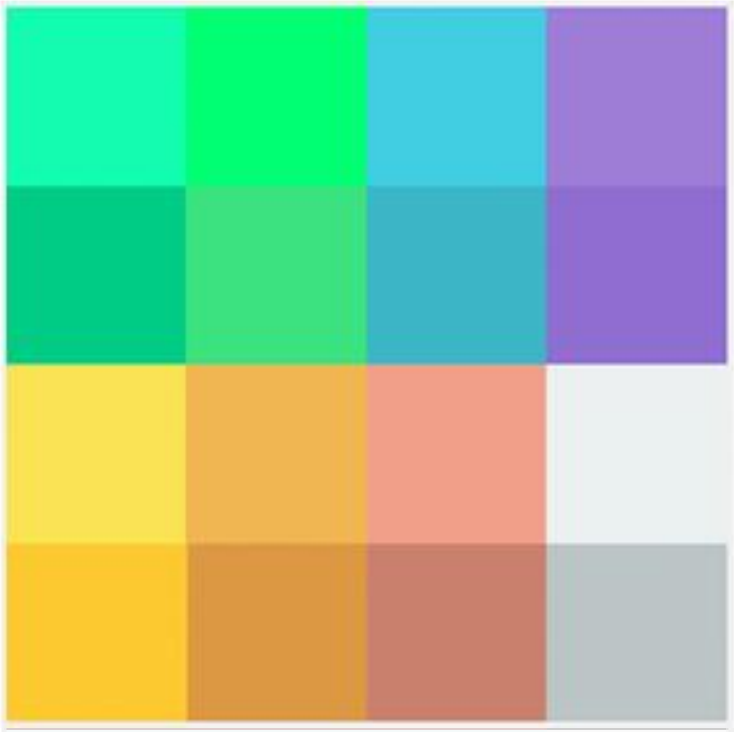


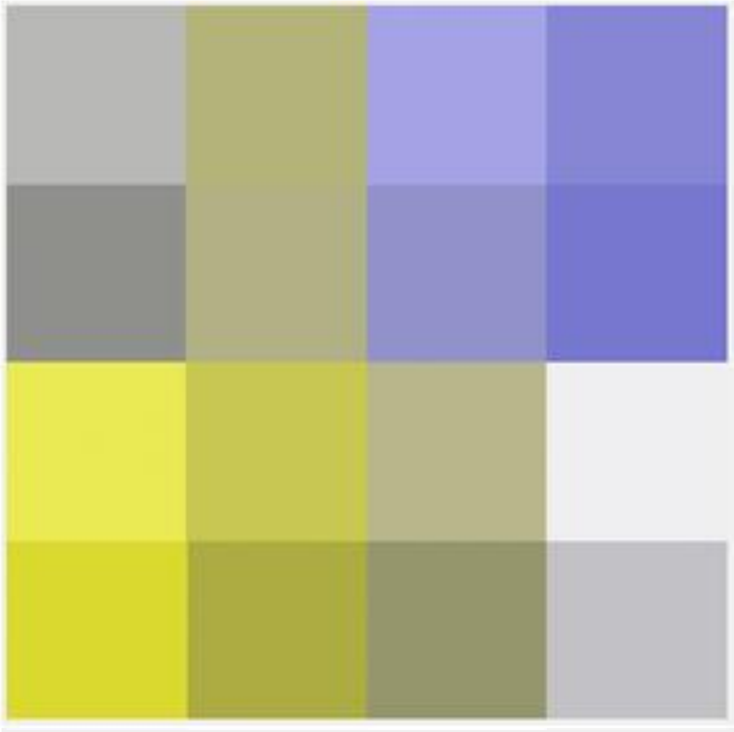


Results (Cont.)

- LMS Daltonization Filter:

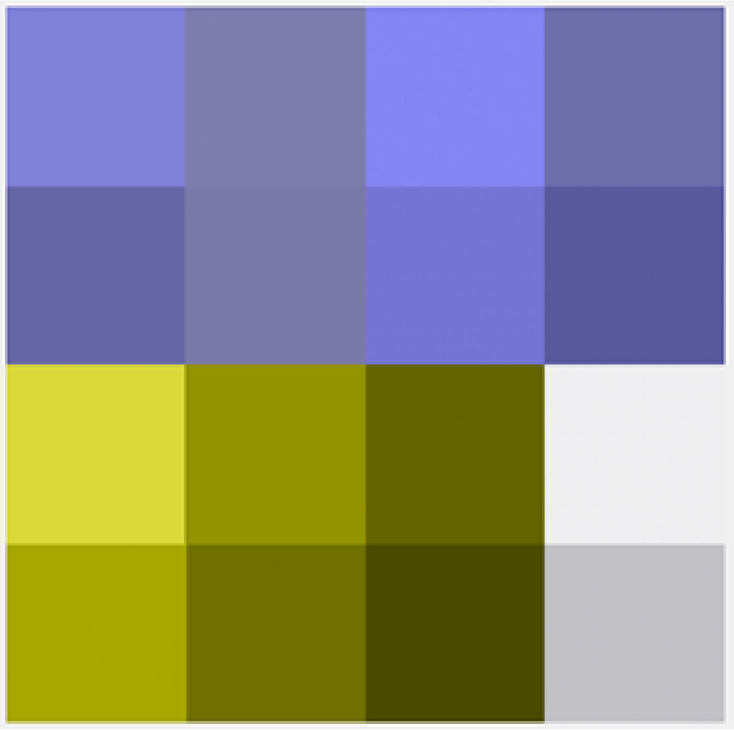






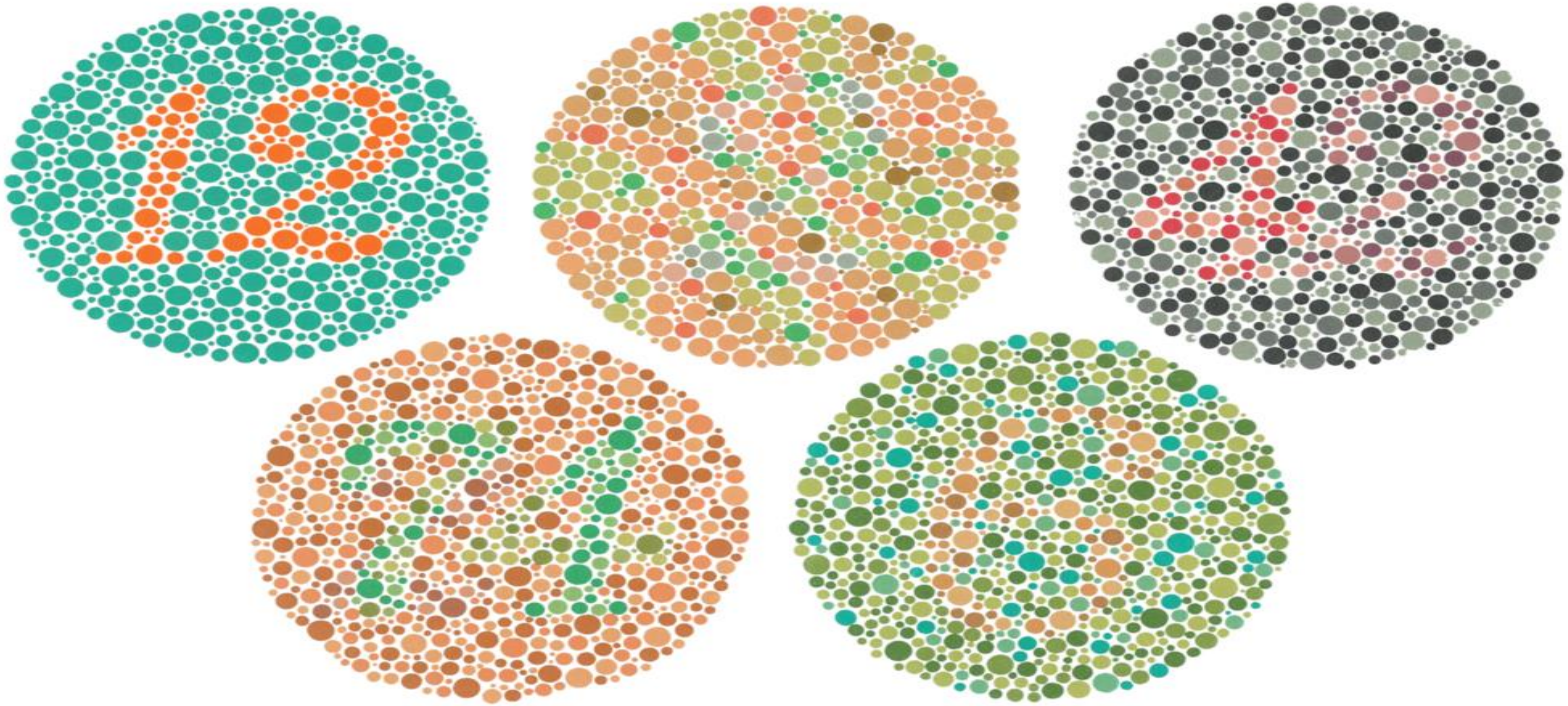
Results (Cont.)

- LAB Color Correction Filter:



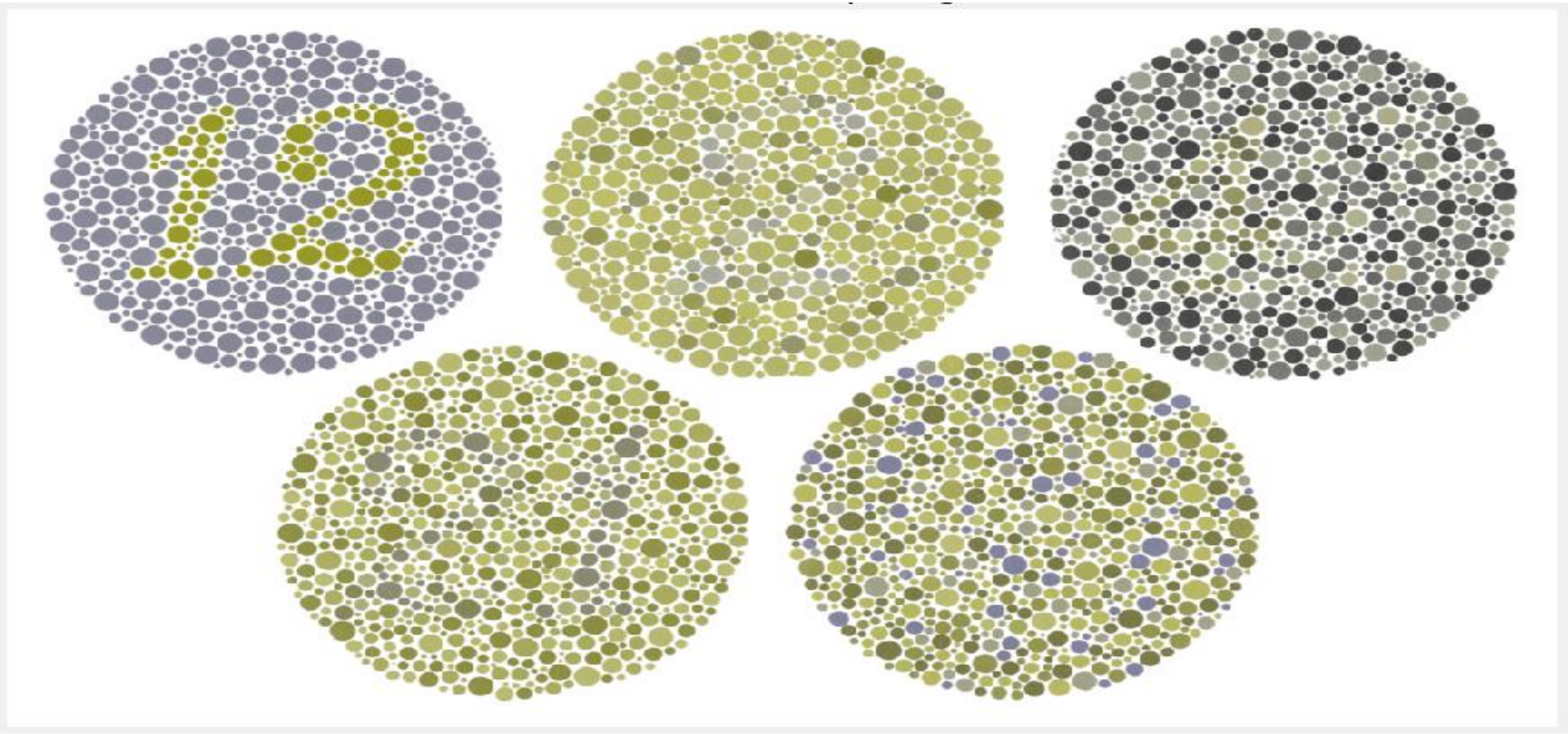
Results (Cont.)

- Color Plates from Dr. Shinobu Ishihara’s test:



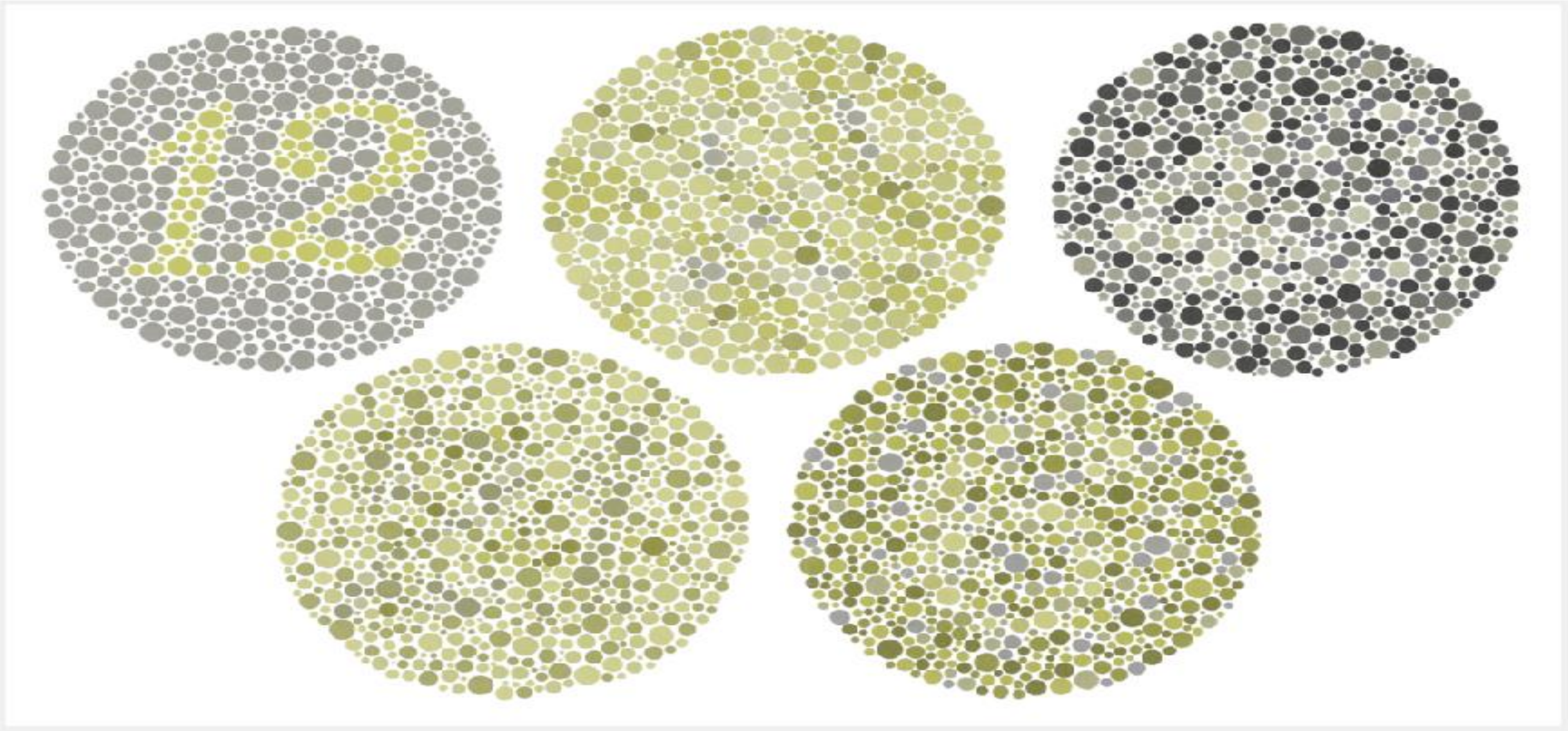
Results (Cont.)

- Color Plate Deuteranopia Simulation:



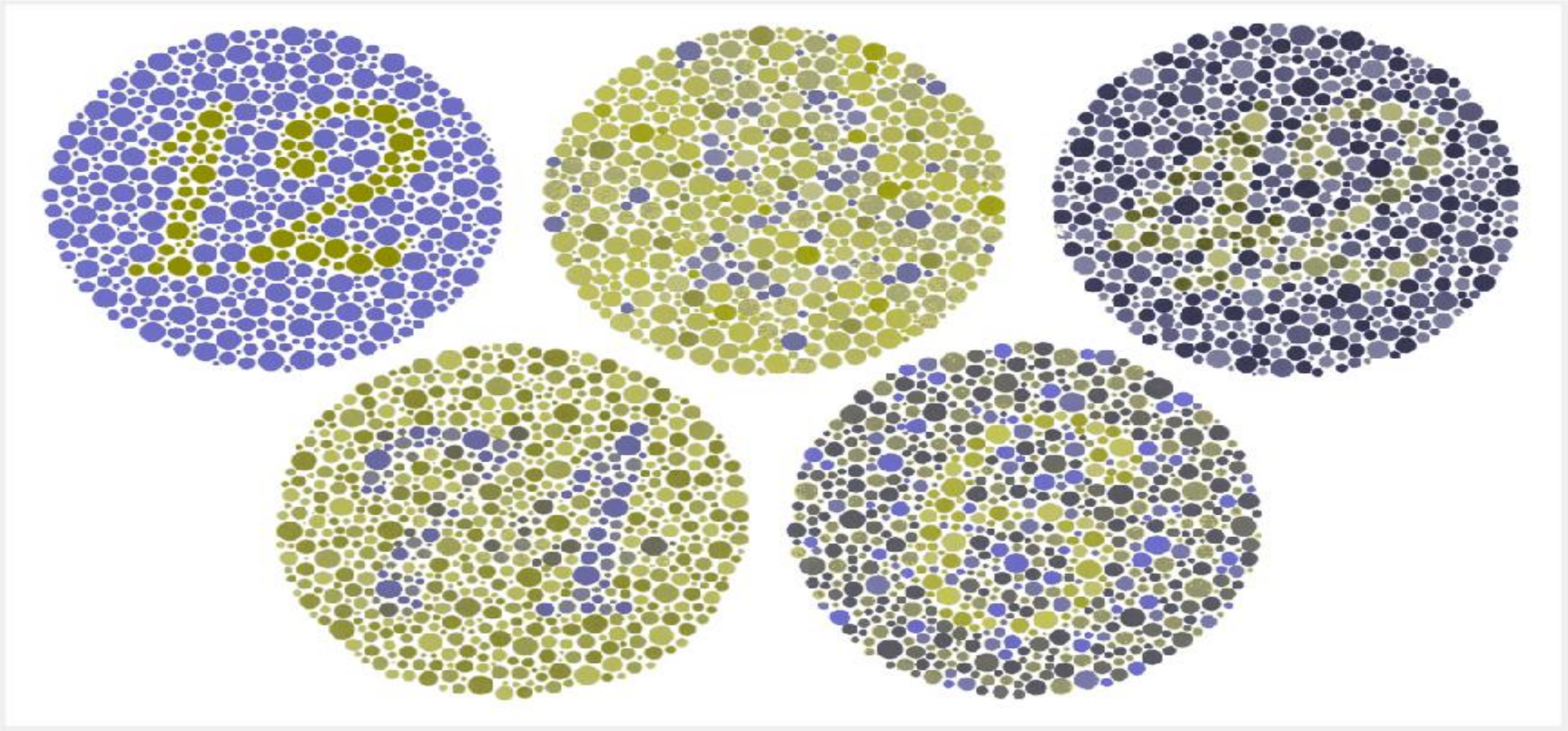
Results (Cont.)

- LMS Daltonization Filter on Color Plates:



Results (Cont.)

- LAB Color Correction Filter on Color Plates:



Questions?

Thank you!!