Chapter 1

Defining Color

School of Electrical Engineering and Computer Science,
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Describing of color

◆ Organizing colors - The desert island experiment

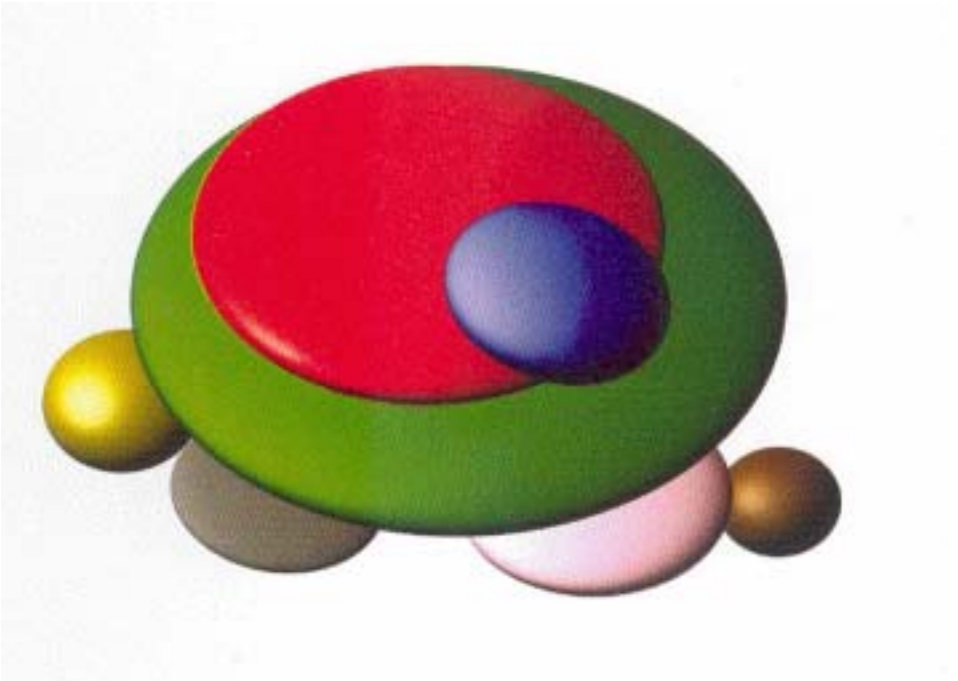

Fig. 1-45. To arrange colored pebbles in an orderly way by color

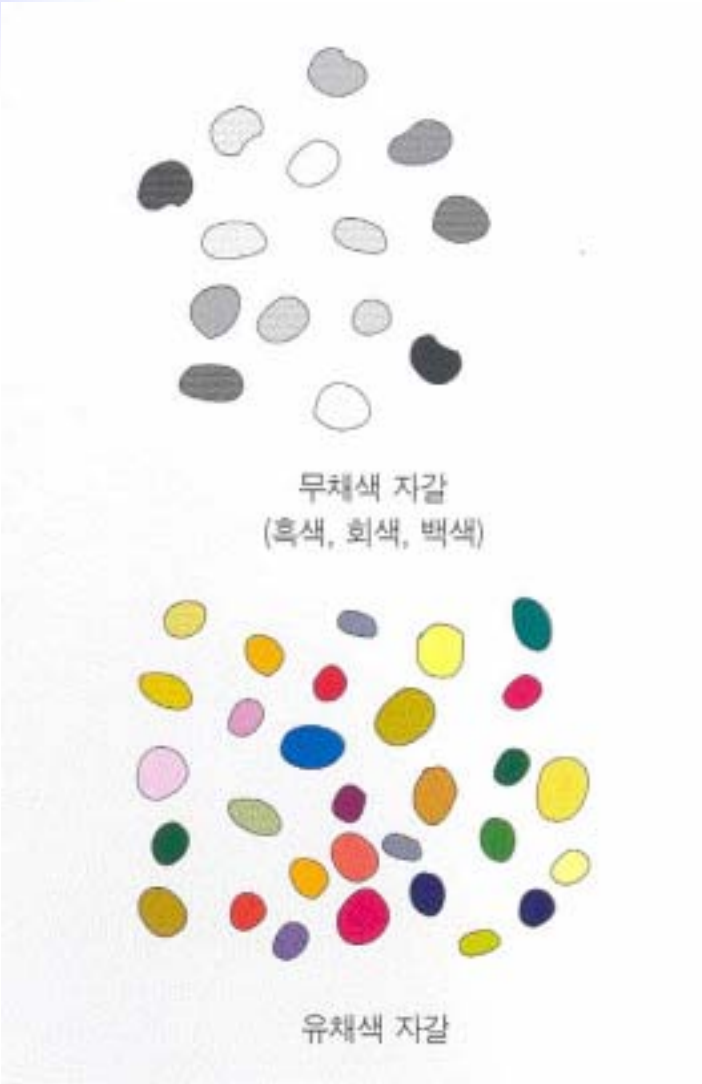

Fig. 1-46. Separating out achromatic stones

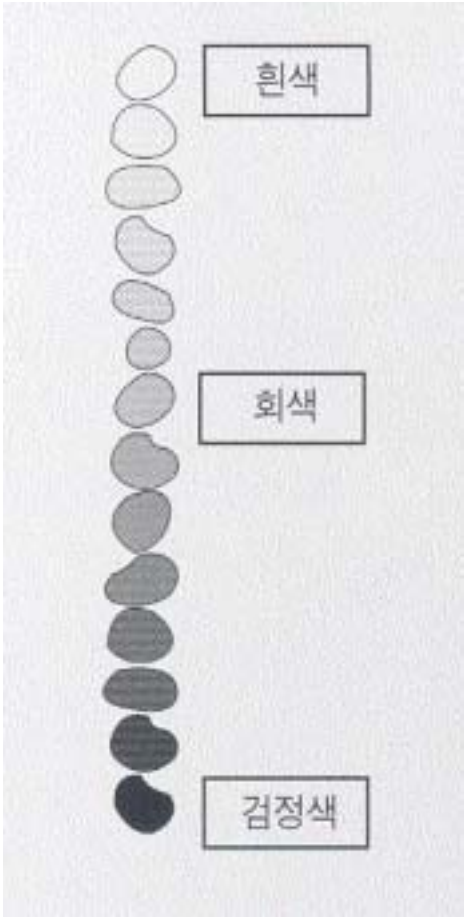

Fig. 1-47. Arranging from white through gray to back

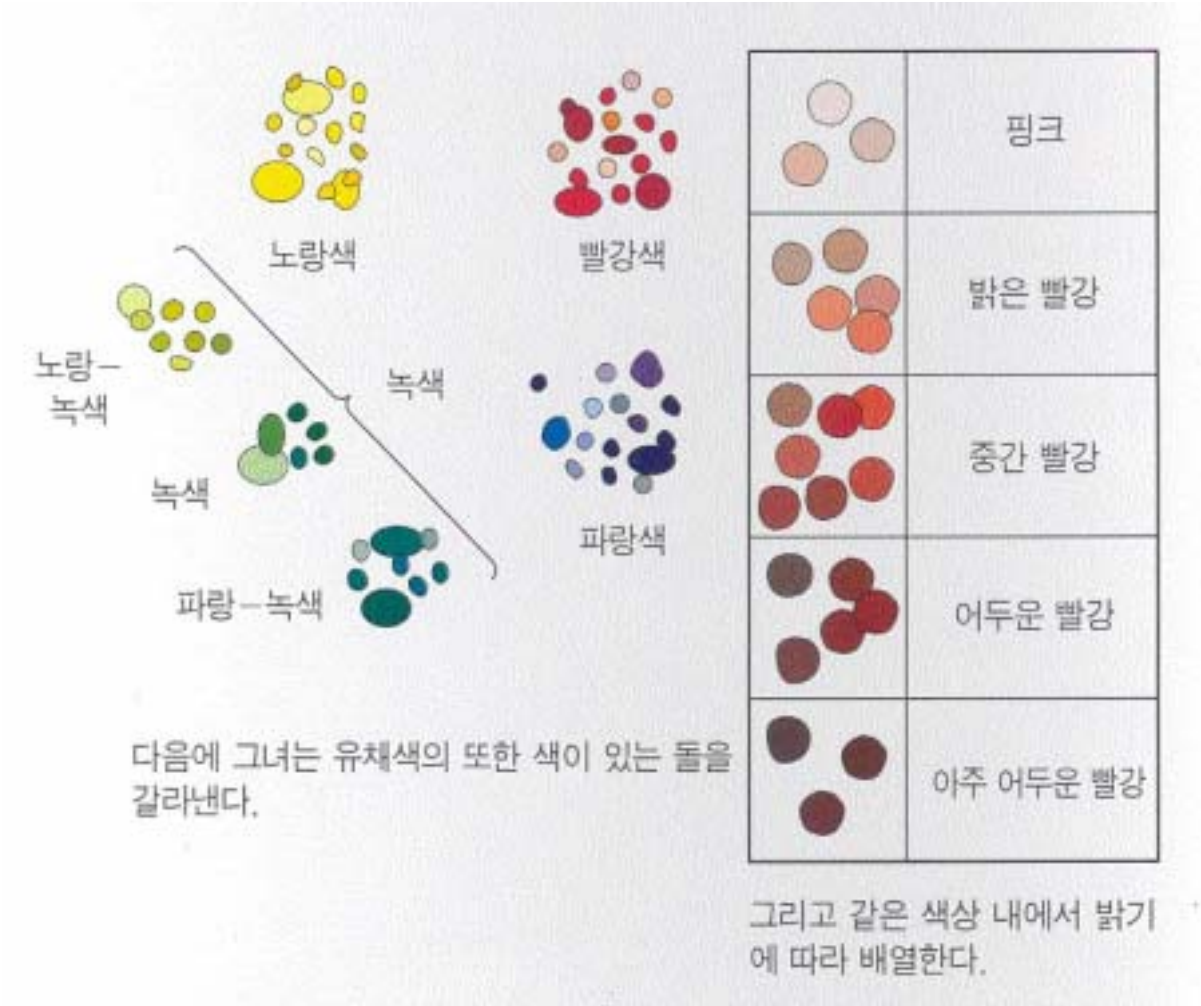

Fig. 1-48. Separating the chromatic then, arranging to lightness within each hue.

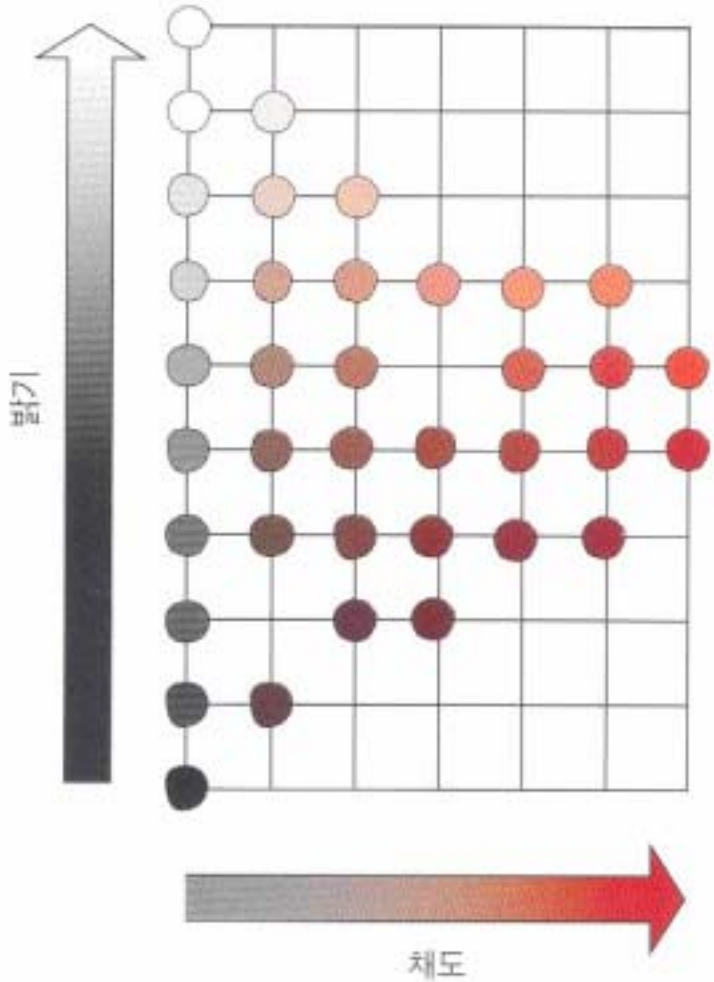

Fig. 1-49. Subdividing on the basis of difference from gray, which we call chroma.

- **Hue**
  - Attribute of a visual perception according to which an area appears to be similar to one of the colors, red, yellow, green, and blue, or to a combination of adjacent pairs of these colors considered in a closed ring
- **Lightness**
  - Attribute by which a perceived color is judged to be equivalent to one of a series of grays ranging from black to white
- **Chroma**
  - Attribute of color used to indicate the degree of departure of the color from a gray of the same lightness

◆ Color coordinates

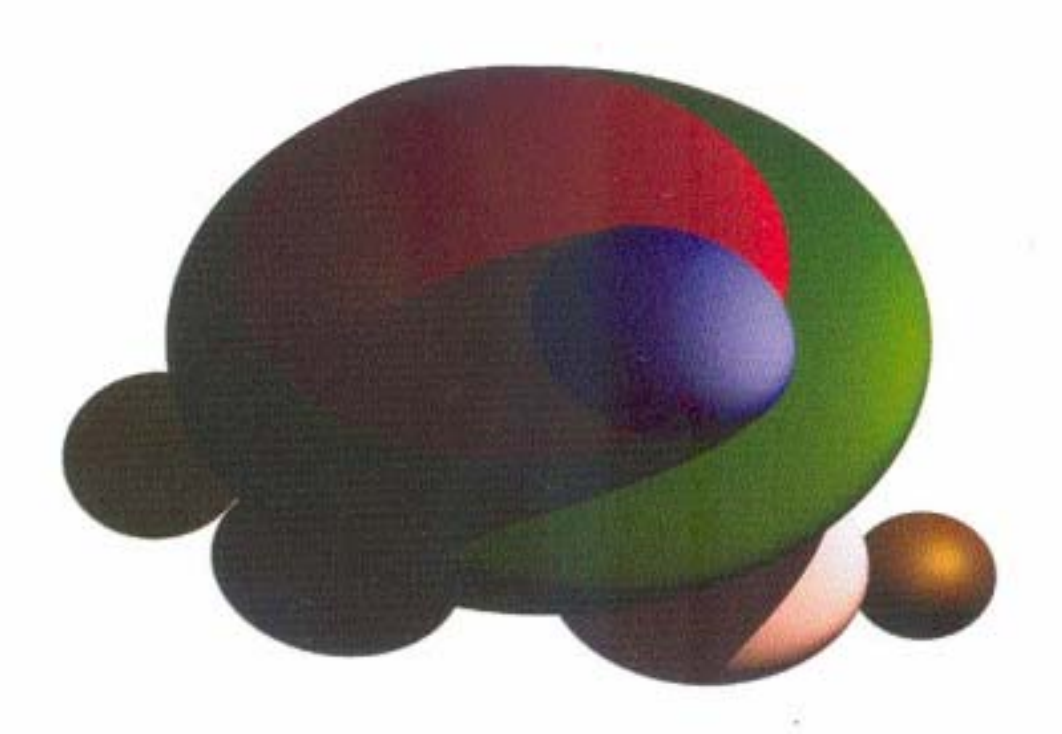

Fig. 1-50. The pebbles shown are illuminated by direct lighting from a low angle, such as occurs at sunset

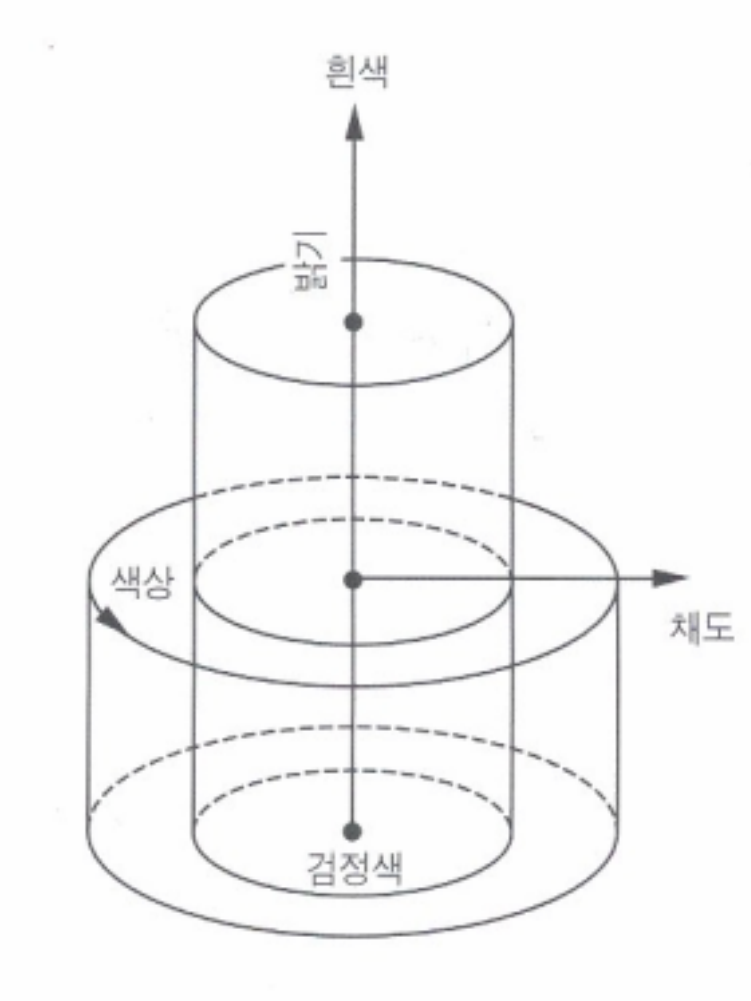

Fig. 1-51. A three-demensional color coordinates system can be developed using coordinates of hue, lightness, and chroma.

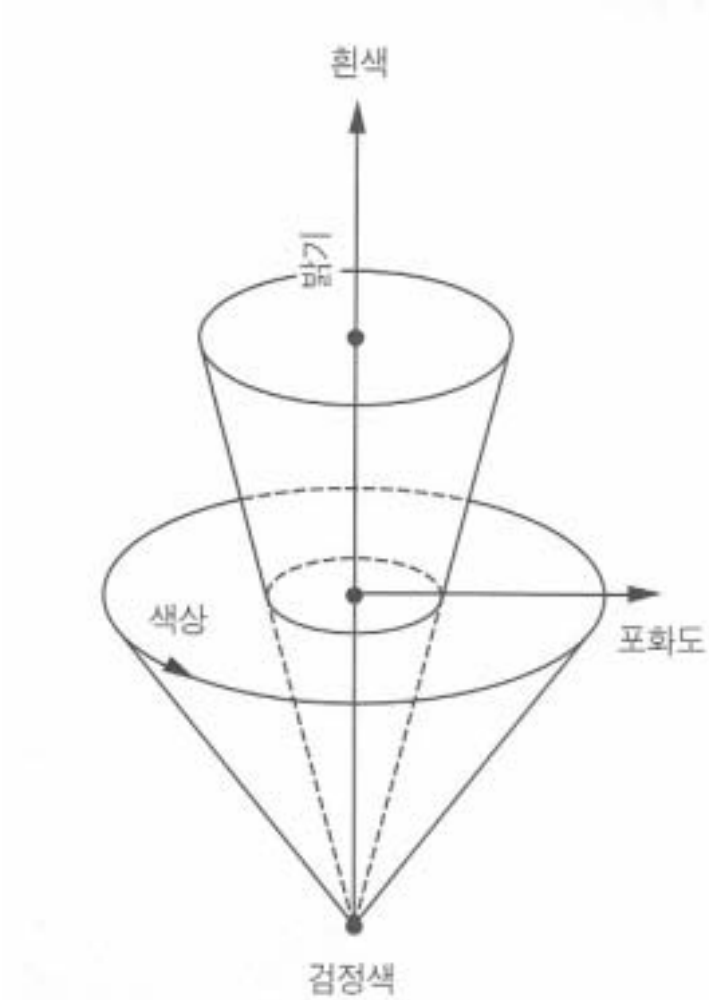

Fig. 1-52. A three-demensional color coordinate system can be developed using coordinates of hue, lightness, and saturation

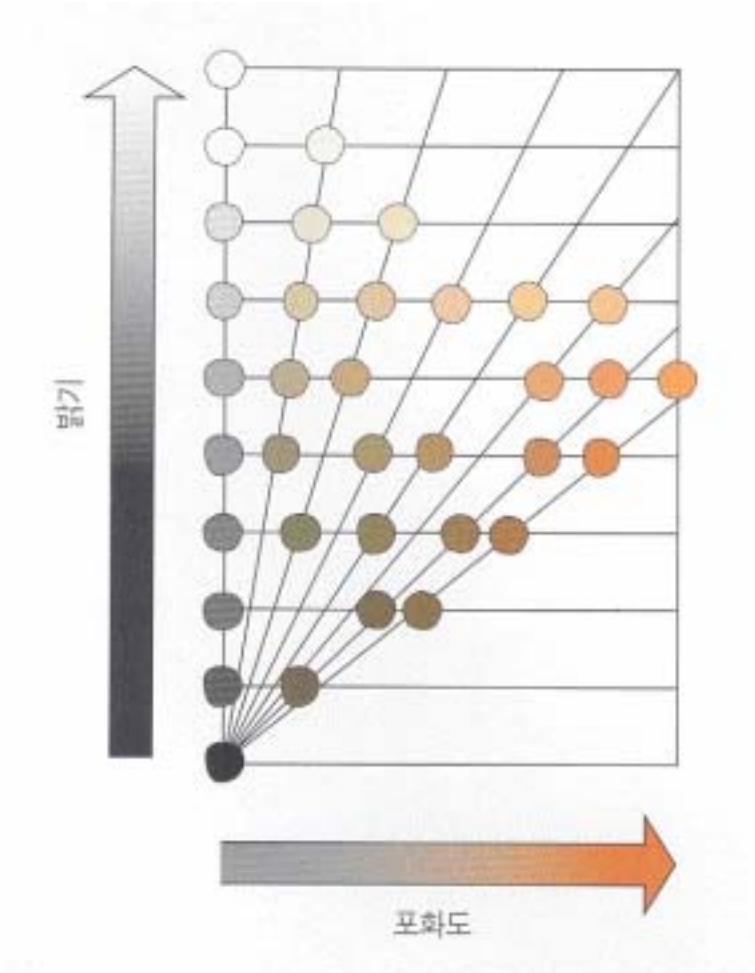

Fig. 1-53. Colors with the same hue can also be organized by their lightness and saturation

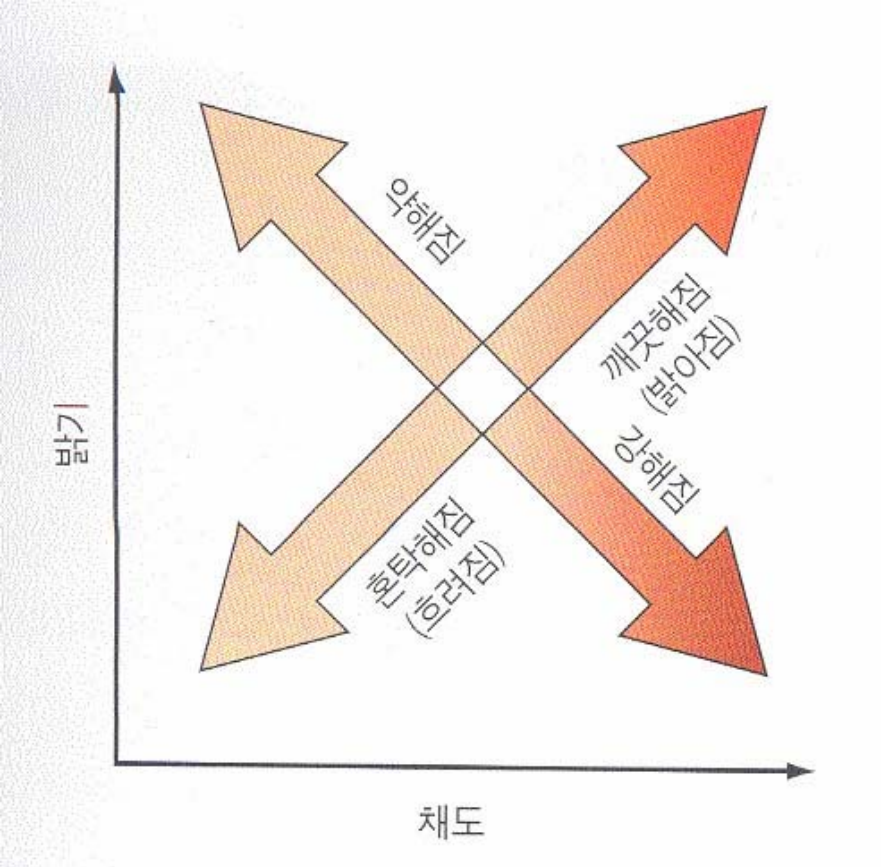

Fig. 1-54. Color coordinates commonly used when coloring materials. Hue or “shade” is the third; it is not considered here.

- Factors affecting color descriptions - The art classroom experiment

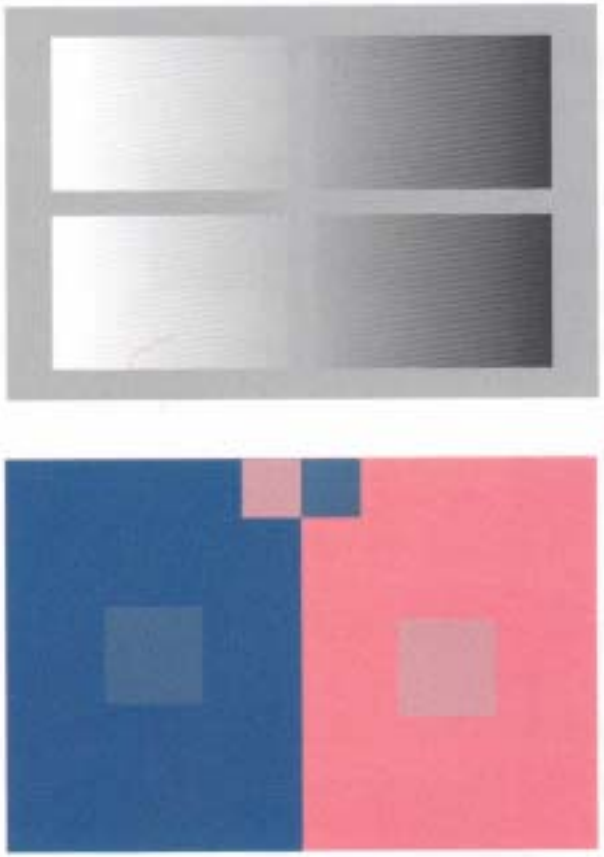

Fig. 1-55. These are examples of simultaneous contrast based on Alber's Interaction of Color(1963)

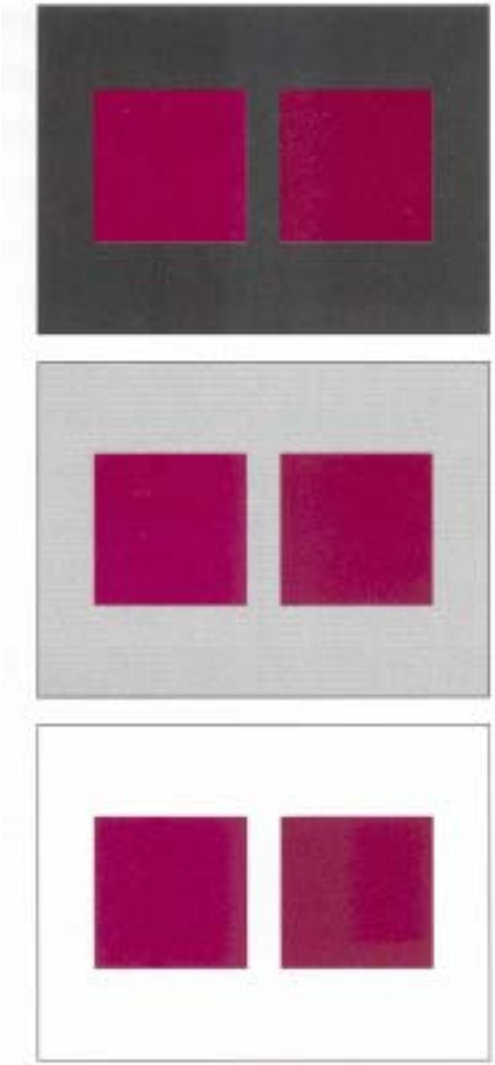

Fig. 1-56. Changing the background lightness affects the perceived color difference of the central pair of colors

◆ Adaptation experiment

– Chromatic adaptation

- Changes in the visual system that approximately compensate for changes in the spectral quality of illumination

– Light adaptation

- Changes in the visual system that approximately compensate for changes in the level of illumination

– Color Constancy

- General tendency of the color of an object to remain constant when the level and color of the illumination are changed

◆ Adaptation experiment

Fig. 1-57. Here, the scene has been photographed with blue light. Although we sense that the lighting is unusual, the color names for each piece of fruit have not changed.

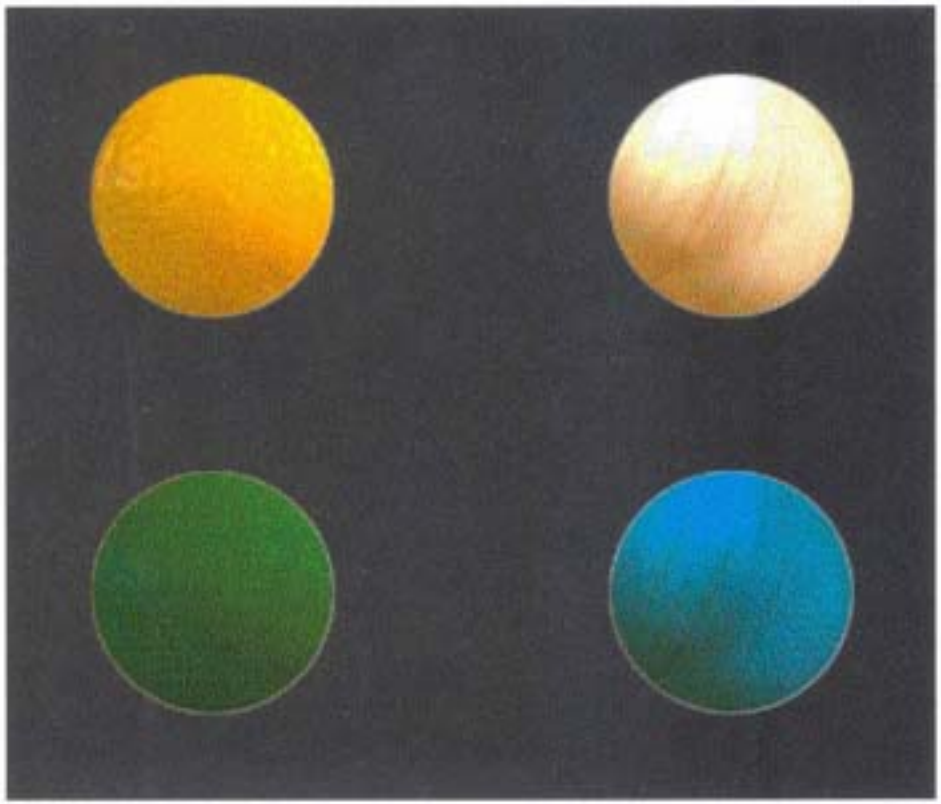

Fig. 1-58. This can be verified by making a mask with black paper with a small hole and placing the mask over the lemon and garlic.

◆ Color appearance

- Aspect of visual perception by which things are recognized by their color

- In psychophysical studies, visual perception in which the spectral aspects of a visual stimulus are integrated with its illuminating and viewing environment

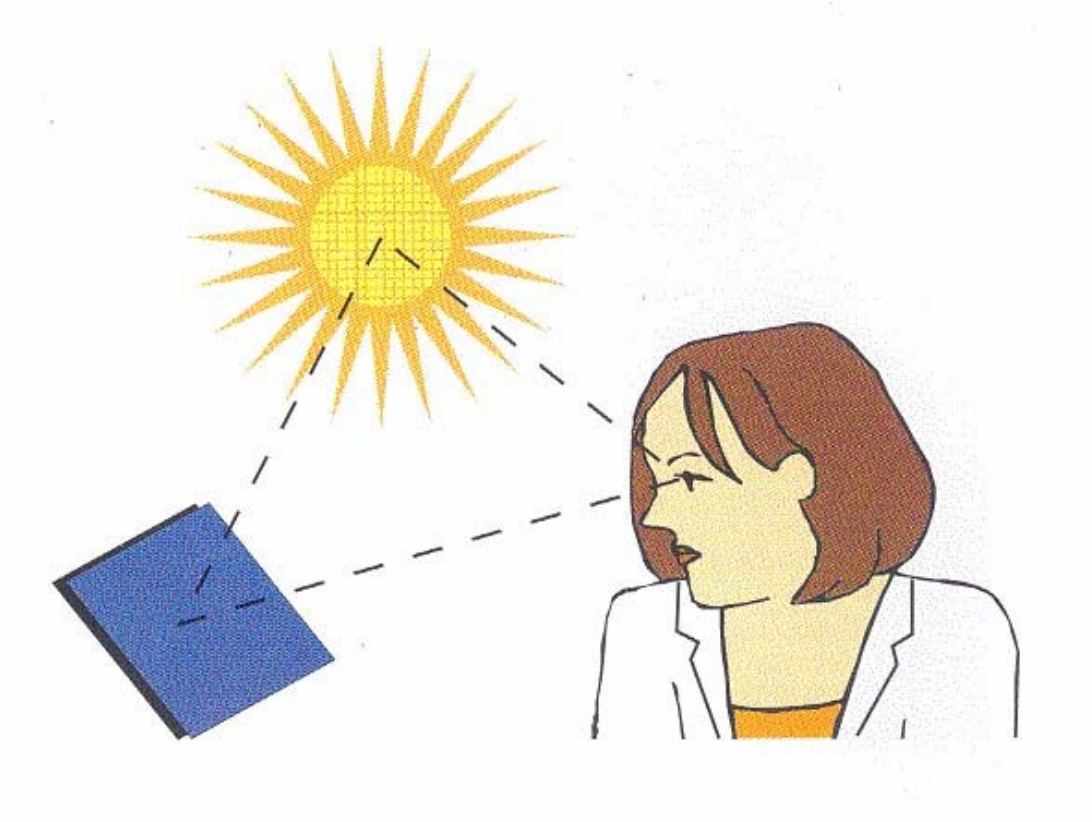

Fig. 1-59. Color appearance models enable the prediction of color names such as blue from physical measurements of an environment and assumptions about how the environment is interpreted by the visual system.

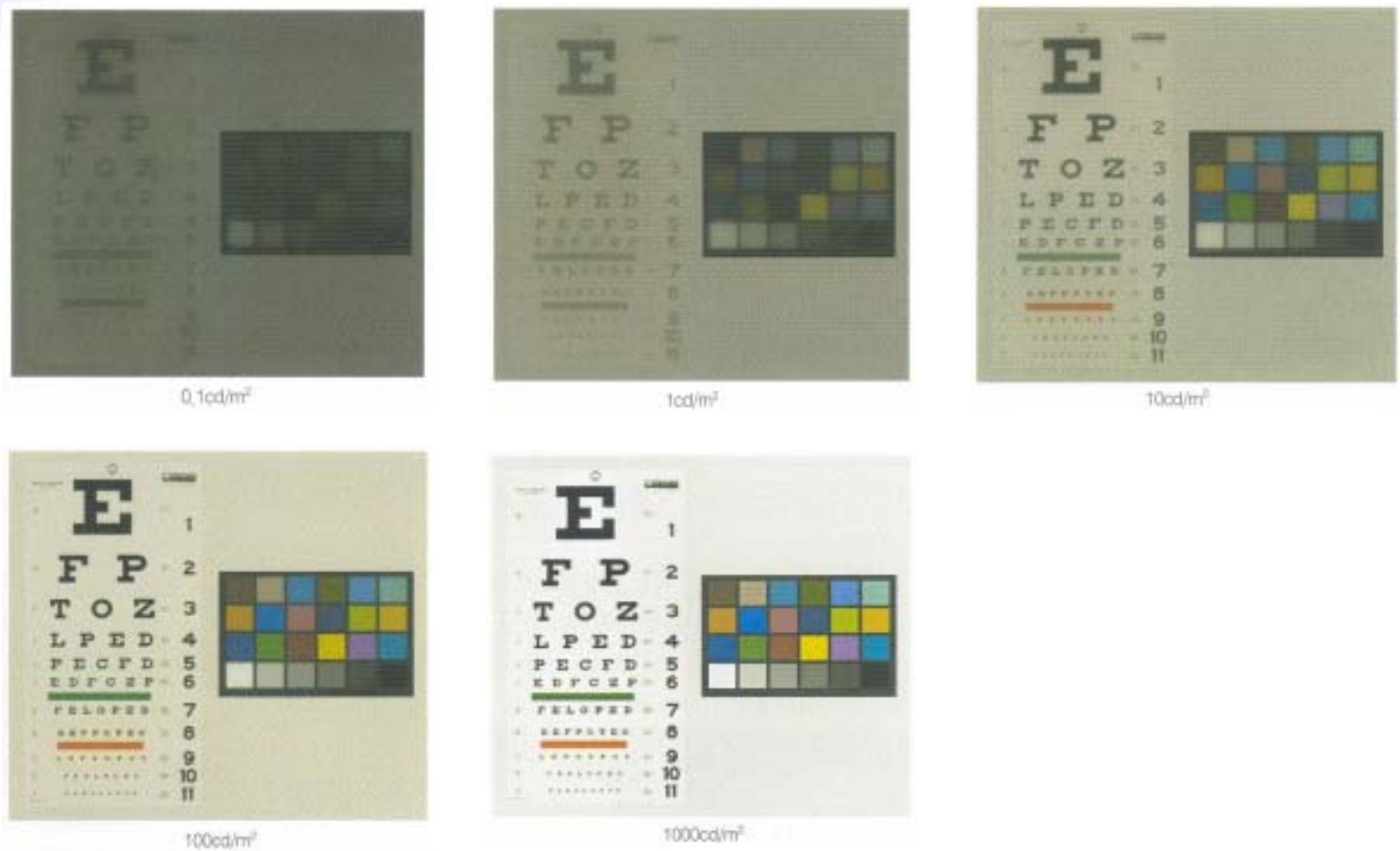

Fig. 1-60. Simulation of the effect of level of illumination on visual perception

Metamerism

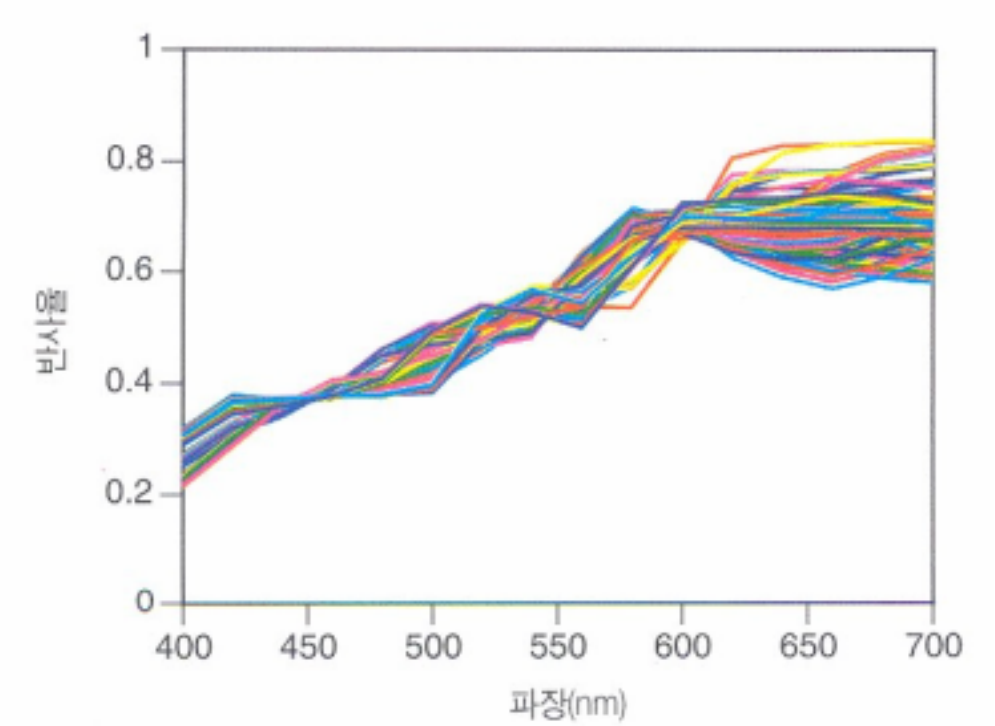

Fig. 1-61. Ensemble of spectral reflectance curves corresponding to three chromatic-pigment recipes all matching a tan material when viewed by an average observer under daylight illumination.

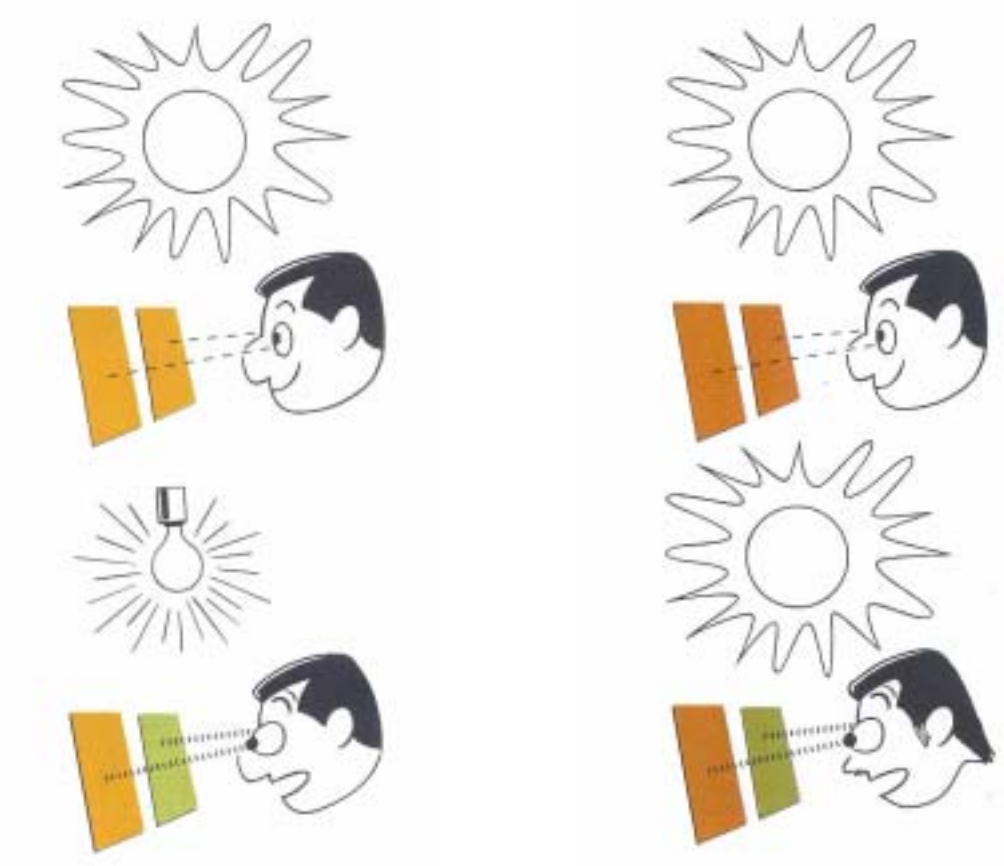

Fig. 1-62, 63 . It is a common fact that pairs of colors with different spectral reflectance cures can match under on set of viewing and illumination conditions, but fail to match under another. They called metameric pairs or matamers. When the mismatch occurs due to a change in illumination and obsever, the phenomenon is called each illuminant matamerism and observer metamerism.

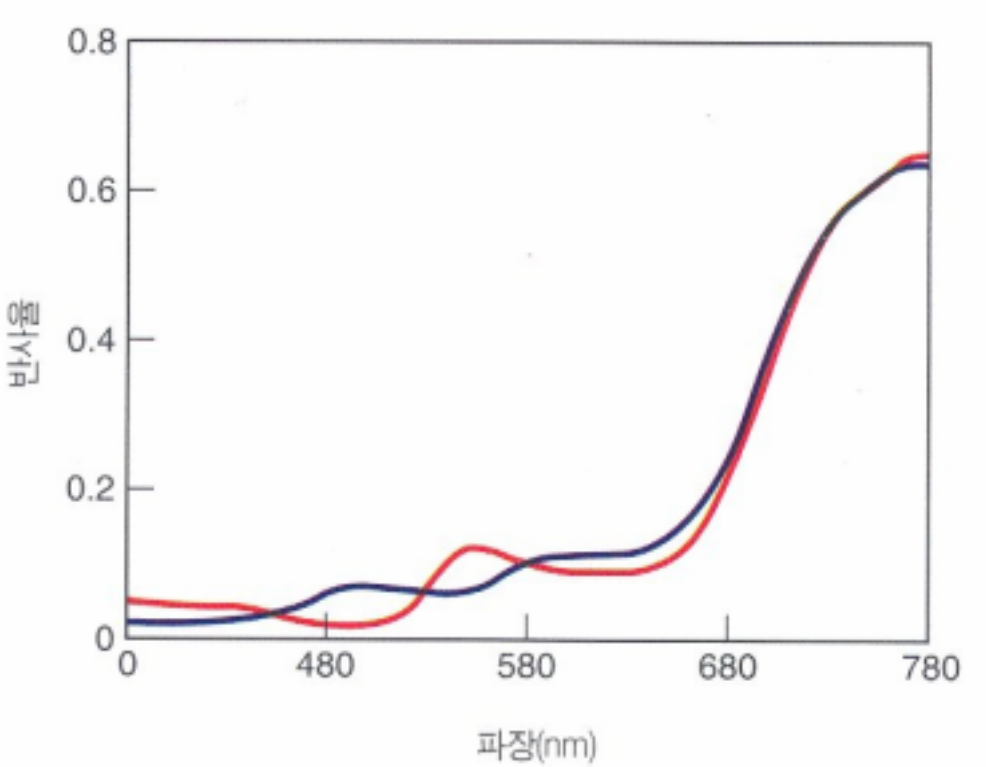

Fig. 1-64. Two wool fabrics, in fact, result in these dramatic difference in color upon changes in either illumination of observer.

- Metameric match:
  - Two specimens that match under a specified illumination and to a specified observer and whose spectral reflectances or transmittances differ in the visible wavelengths. We also call this a **conditional match**

- Spectal match:
  - Two specimens that have identical spectral reflectances or transmittances. Accordingly, they match under all conditions of illumination and for all observers. We also call this an **invariant match**

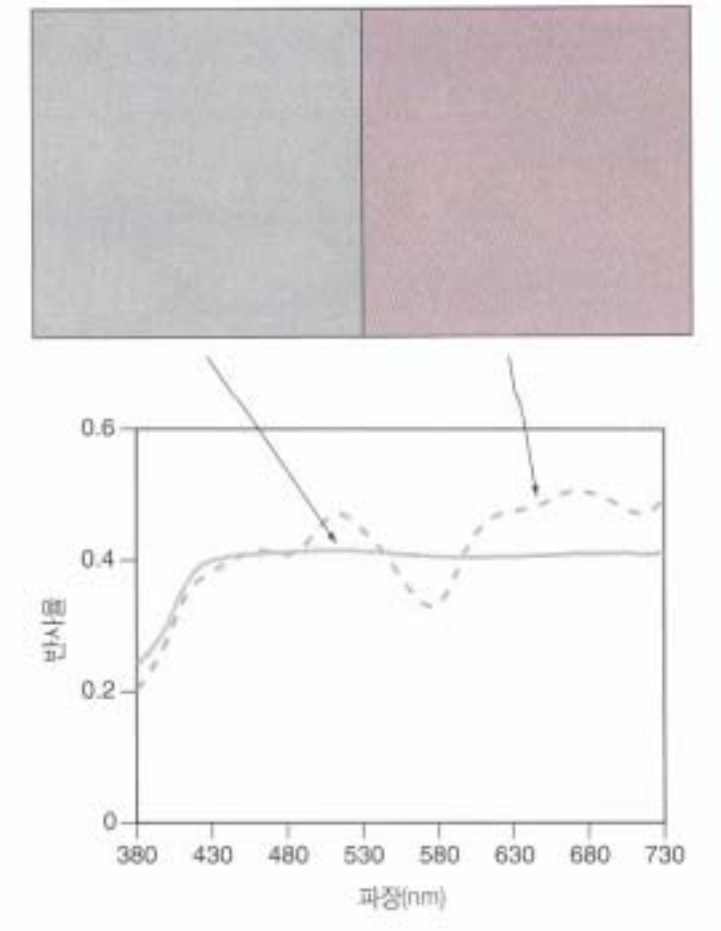

Fig. 1-65. The square on the left-hand side is printed with just black ink while the square on the right-hand side is printed with cyan, magenta, and yellow inks.

Summary

- Color is an integral part of our daily lives.
  - It is very complex perception.
  - We only have to understand the principles of color physics, chemistry, and vision