

Our Color Vision is Limited

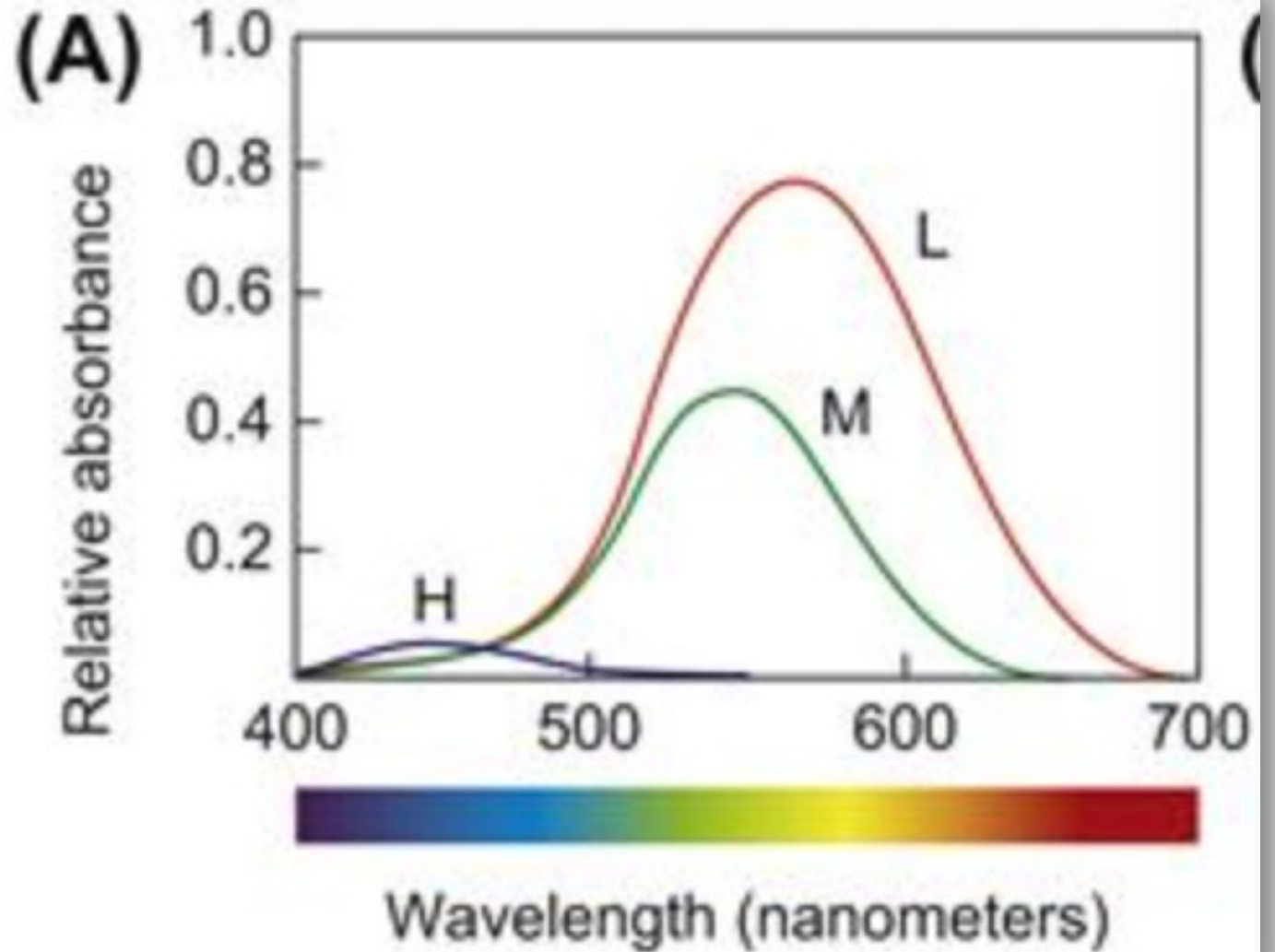
Duc Dao

Overview of Visual System

- Light receptor cell types: rods & cones
- Rods: detect light levels
 - Poorly lighted env: useful
 - Well lighted env: no additional info
- Cones: detect colors

Color Input

- Cones types:
 - Low frequency
 - Medium frequency
 - High frequency

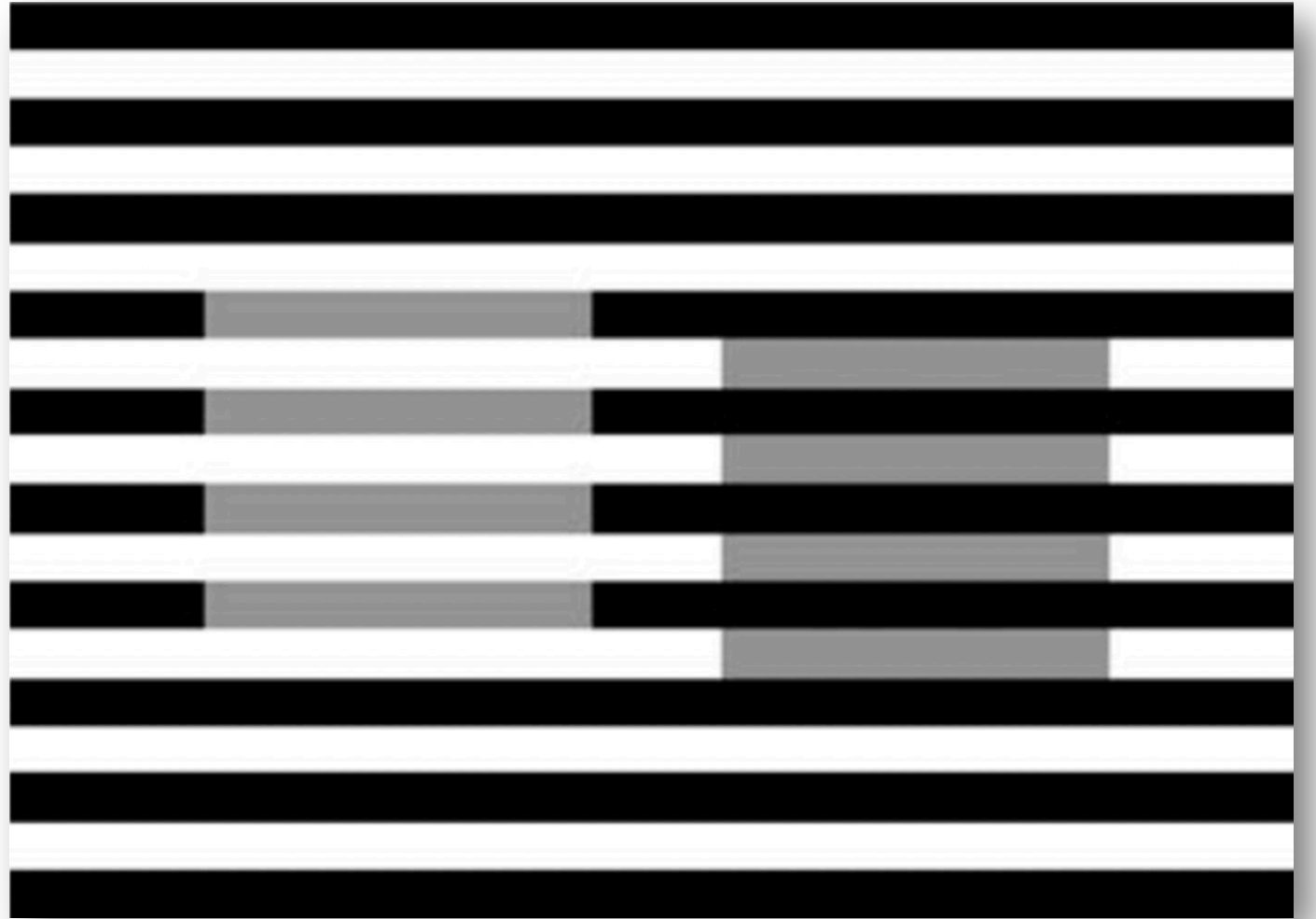


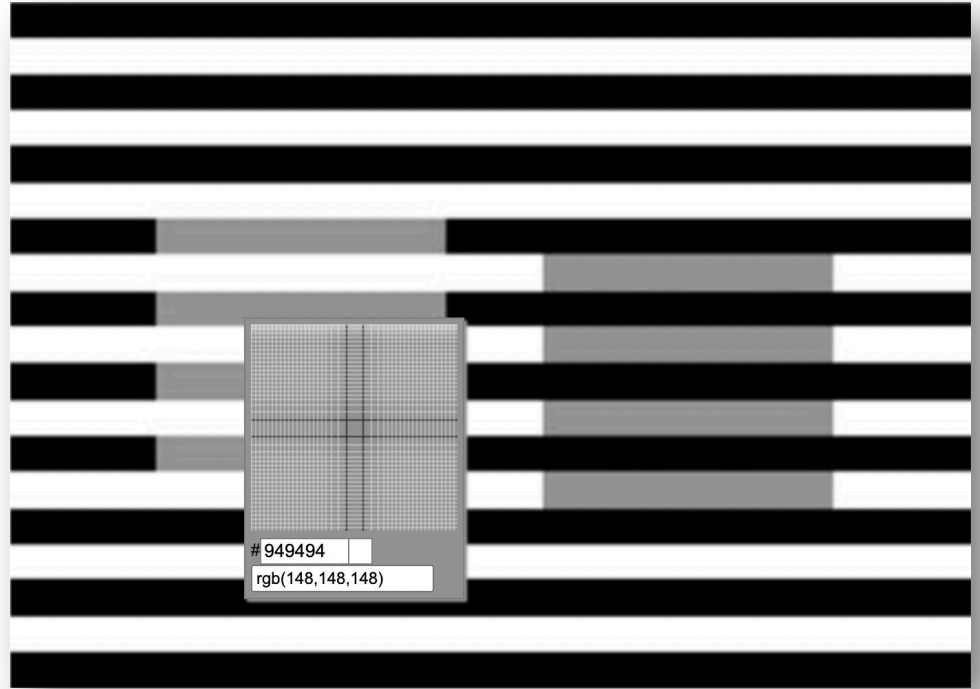
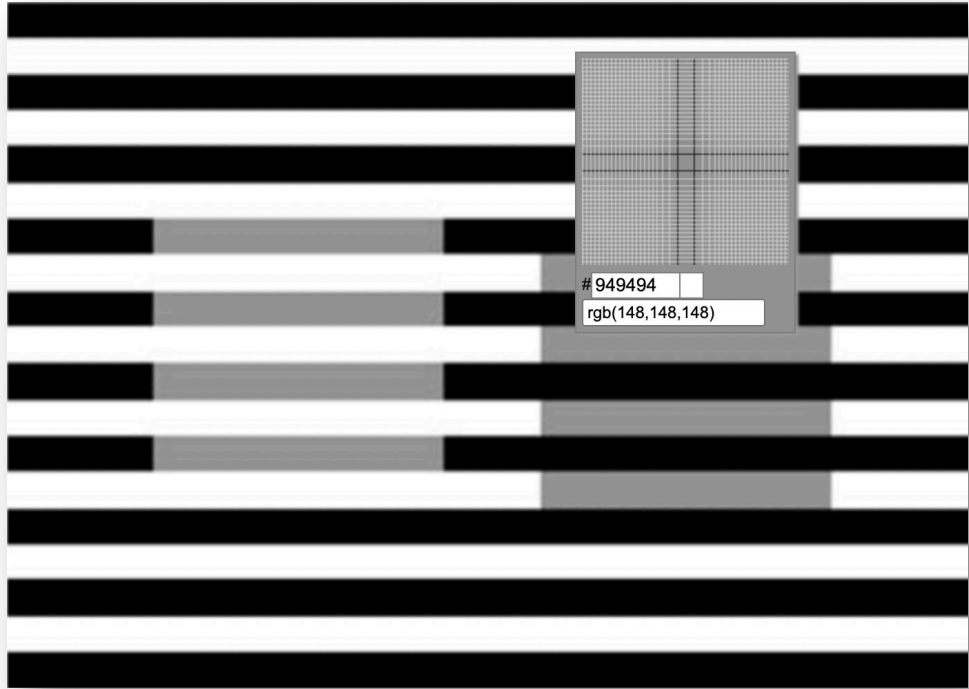
How We See Color

- Combine signal: subtraction
- Signal channel:
 - Red-green difference: subtract medium – low frequency
 - Yellow-blue difference: subtract high – low frequency
 - Black-white: add low – medium frequency
 - => color-opponent channels

Vision is Optimized for Contrast, Not Brightness

sensitive to differences in color
and brightness





Factors Effect Color Visibility

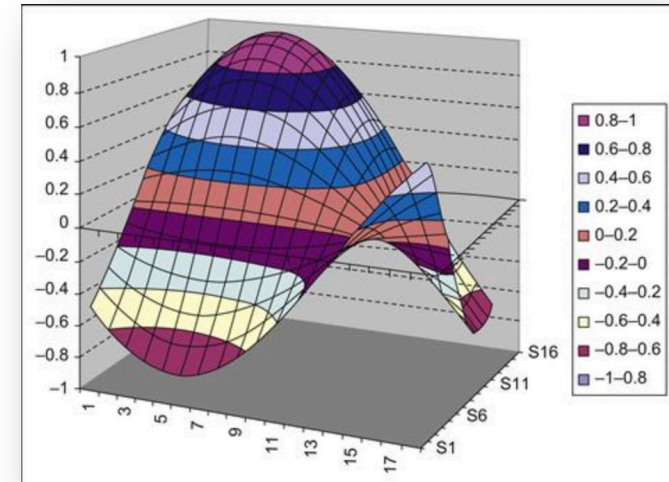
Color Presentation, Color-Blindness, and External Factors

Colors Presentation

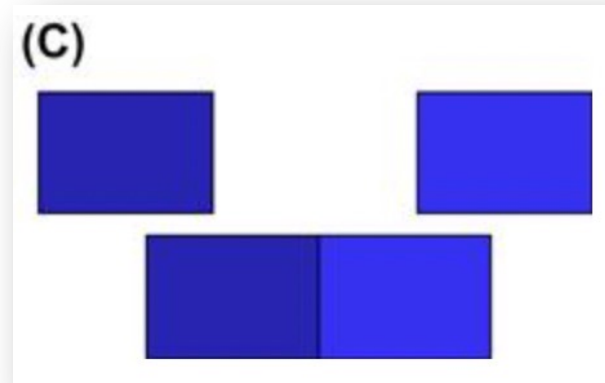
Paleness

- [Housing Units Authorized, Percent Change October 2005 Year-to-Date Compared With a Year Earlier](#)
- [Electricity Consumption per Capita, 2001](#)
- [Drinking and Wastewater Needs per Capita, 2003 Dollars](#)
- [Manufactured Homes as a Percent of Total Homes, 2000](#)
- [Percent of Occupied Housing Units That Are Owner Occupied](#)
- [Percent Change in Private Employment Due to Growth/Decline in Establishments, 2000-2001](#)
- [Labor-Force Participation Rate, 2002](#)
- [Number of Bank Offices per 10,000 People, 2003](#)
- [Total Foreign-Born, 2000](#)
- [Retail Gasoline Prices, May 17, 2004](#)
- [Total Manufactured Exports per Capita, 2003](#)
- [House Price Index, Percent Change-Third Quarter 2002 to Third Quarter 2003](#)
- [State and Local Government Per Capita General Fund Expenditure, 1977-2000](#)

Color patch size

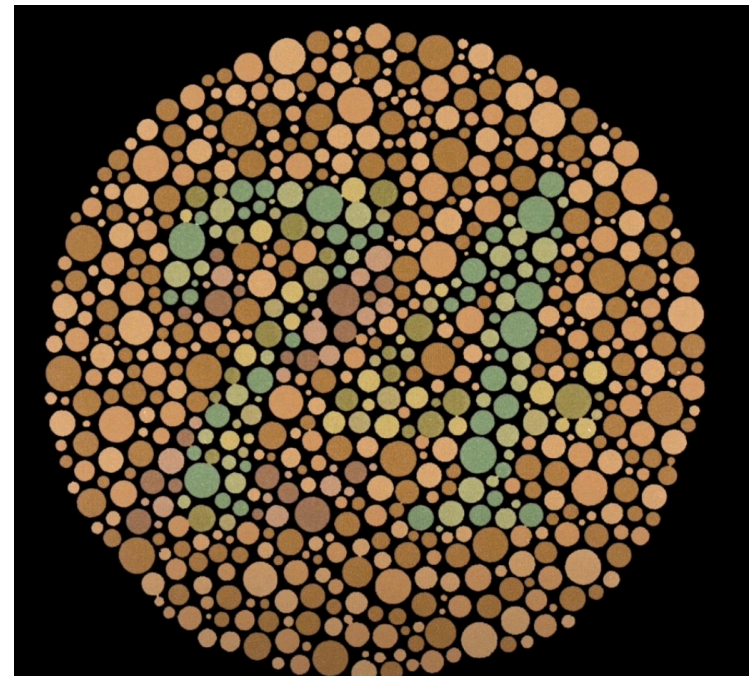
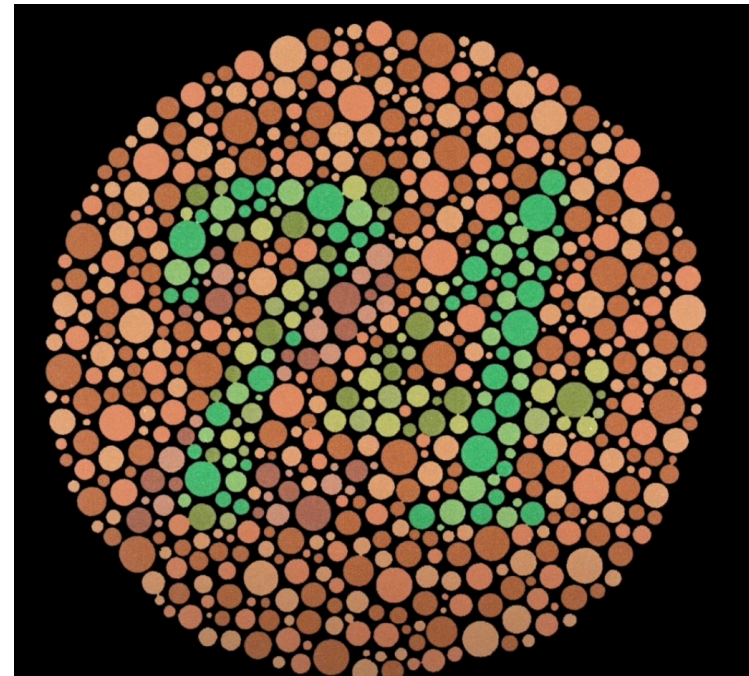


Separation



Color-Blindness

- color subtraction channels don't function normally
- Most common: red-green



External Factors

- Variation among color displays
- Grayscale displays
- Display angle
- Ambient illumination

Guidelines for Using Color

- Separate colors by saturation, brightness, and hue
- Use colors: red, green, yellow, blue, black, and white
- Avoid color pairs that color-blind people cannot distinguish
 - No dark reds, blues, or violets against dark colors
- Use color redundantly with other cues
- Separate strong opponent colors

Thank You