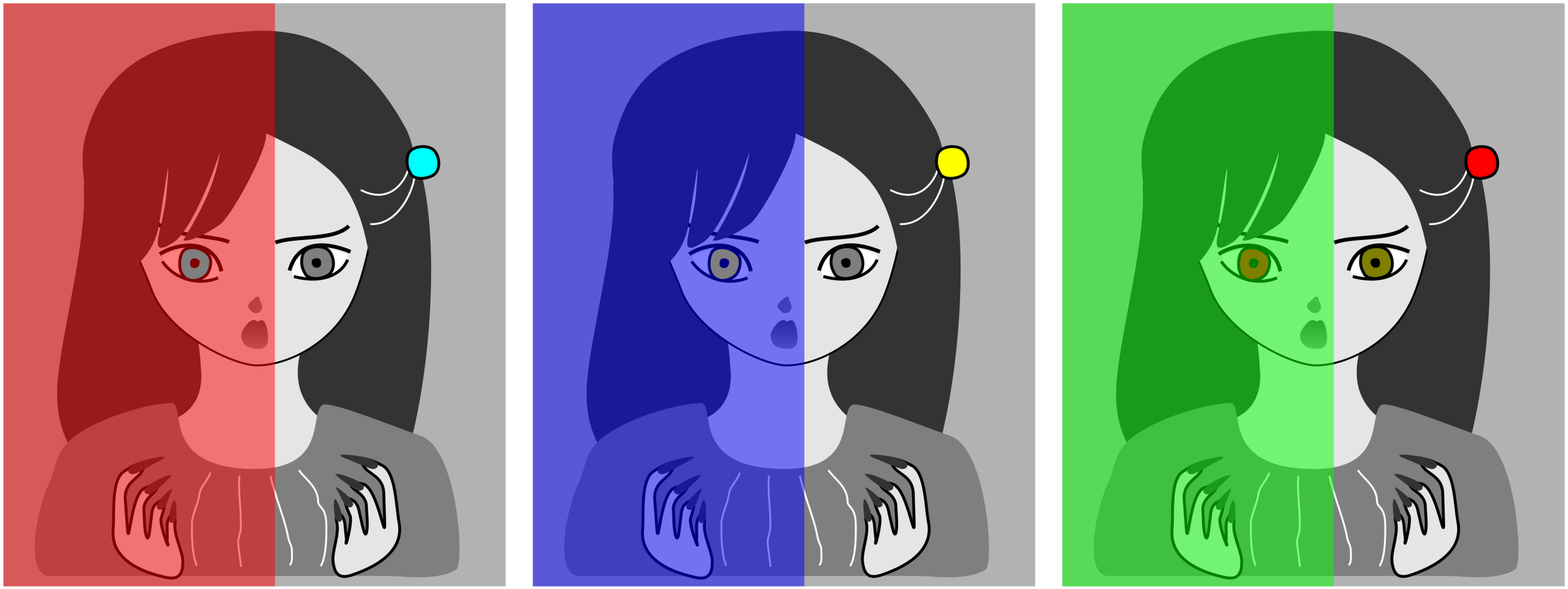
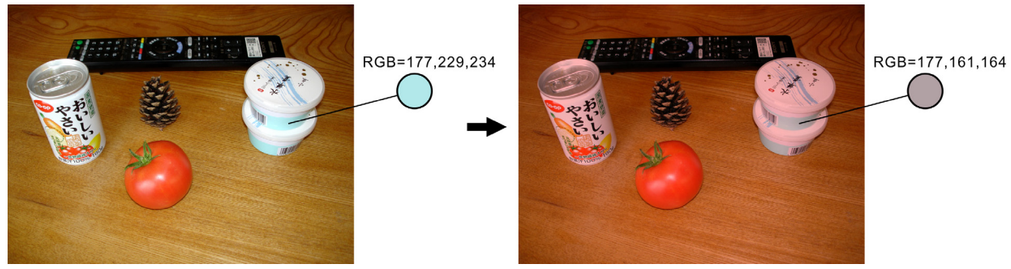
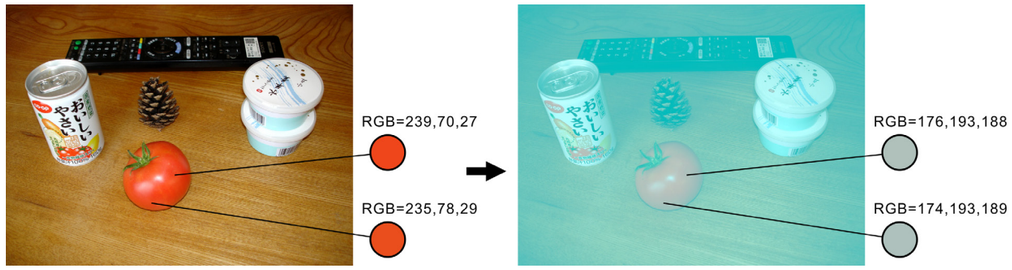
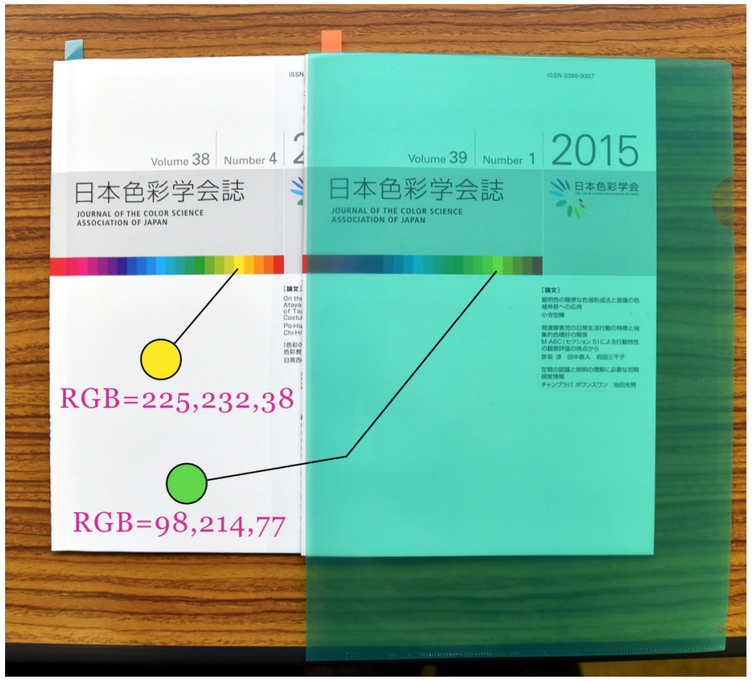
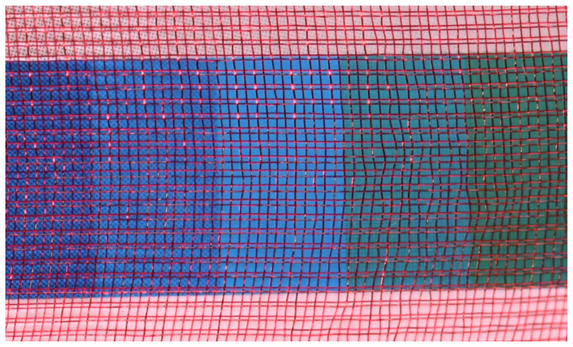
Color Illusions Accompanied by Color Constancy Phenomena

Akiyoshi Kitaoka (Ritsumeikan University)



The right eye appears to be bluish in the leftmost panel, yellowish in the middle, and reddish in the rightmost panel, though the right eye is the same color as the left one for each panel.

Ref. Kitaoka, A. (2009). A brief classification of colour illusions. Talk at the 11th Congress of the International Colour Association (AIC 2009), Sydney.

	Multiplicative color change (giving transparent appearance)	**Additive color change** (giving translucent appearance)
Color illusion		
Actual examples		 
Formula	If the color of a pixel in the target image is (r_o, g_o, b_o), the color of the filter is (r_f, g_f, b_f), and its transmittance is τ $(0 \leqq r_o, g_o, b_o, r_f, g_f, b_f, \tau \leqq 1)$, then the resulting color is given as $((\tau + (1-\tau) r_f) r_o, (\tau + (1-\tau) g_f) g_o, (\tau + (1-\tau) b_f) b_o)$.	If the color of a pixel in the target image is (r_o, g_o, b_o), the color of the filter is (r_f, g_f, b_f), and its transmittance is τ $(0 \leqq r_o, g_o, b_o, r_f, g_f, b_f, \tau \leqq 1)$, then the resulting color is given as $(\tau r_o + (1-\tau) r_f, \tau g_o + (1-\tau) g_f, \tau b_o + (1-\tau) b_f)$.

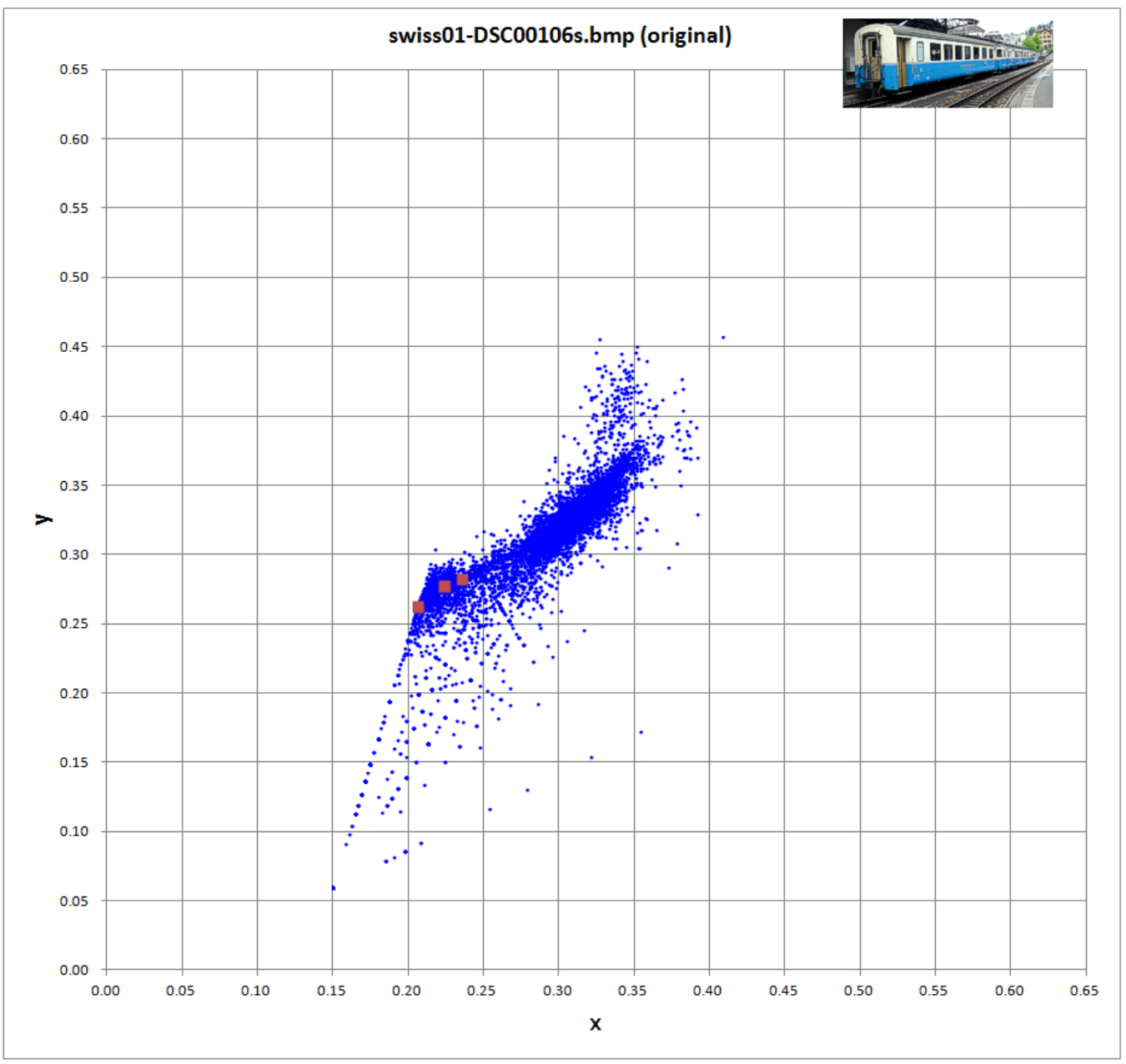
Original image

(R, G, B) = (0, 95, 158)
(x, y) = (0.2060, 0.2616)

(R, G, B) = (21, 141, 210)
(x, y) = (0.2233, 0.2774)

(R, G, B) = (37, 136, 198)
(x, y) = (0.2349, 0.2815)

Values x and y were obtained using the formula from sRGB to XYZ.



Two-colored image (modified Land's method)

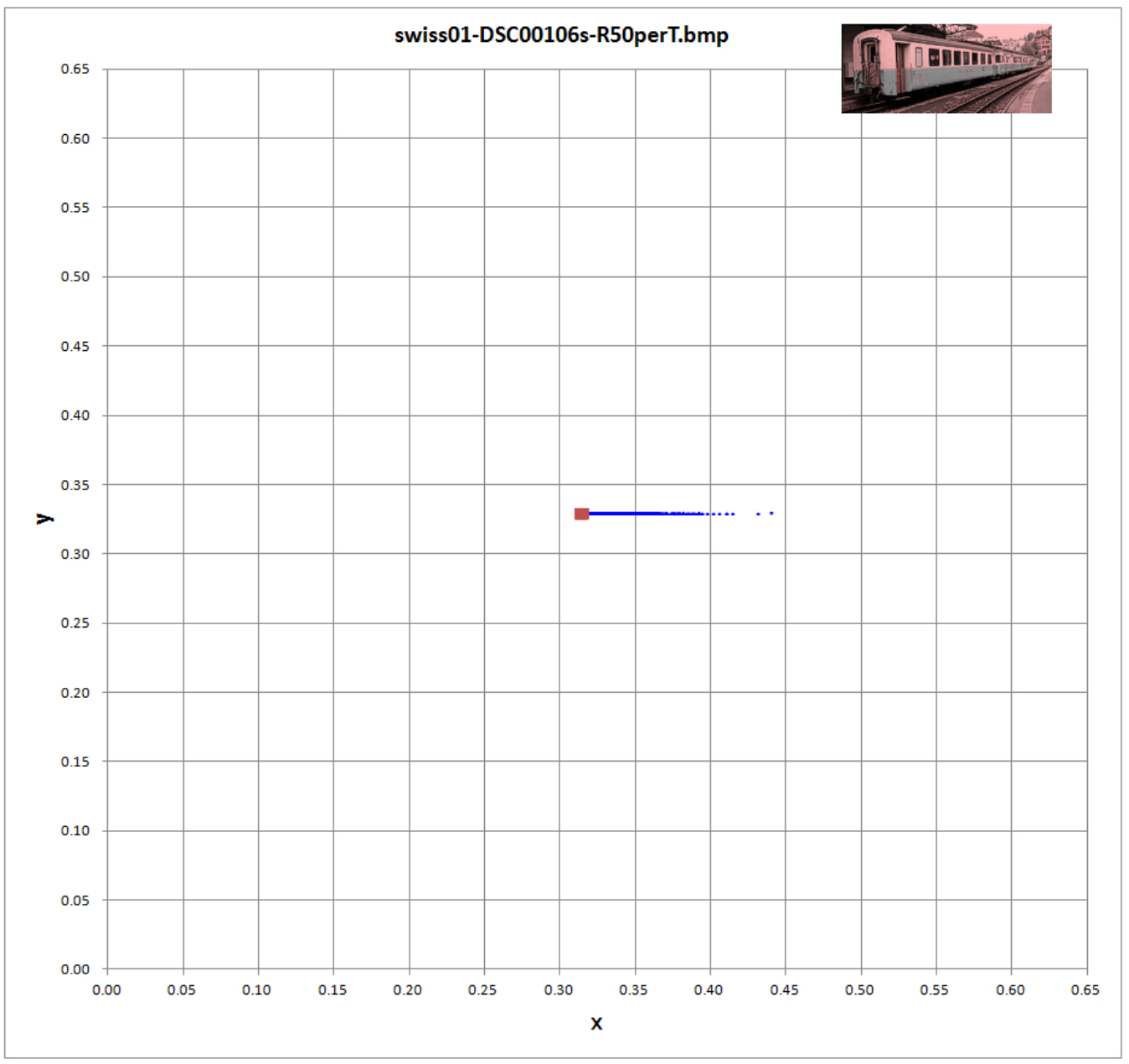
(red 50%)

(R, G, B) = (95, 95, 95)
(x, y) = (0.3127, 0.3290)

(R, G, B) = (132, 131, 131)
(x, y) = (0.3132, 0.3290)

(R, G, B) = (127, 124, 124)
(x, y) = (0.3144, 0.3290)

Gray or nearly gray appears to be bluish.



Additively color-changed image

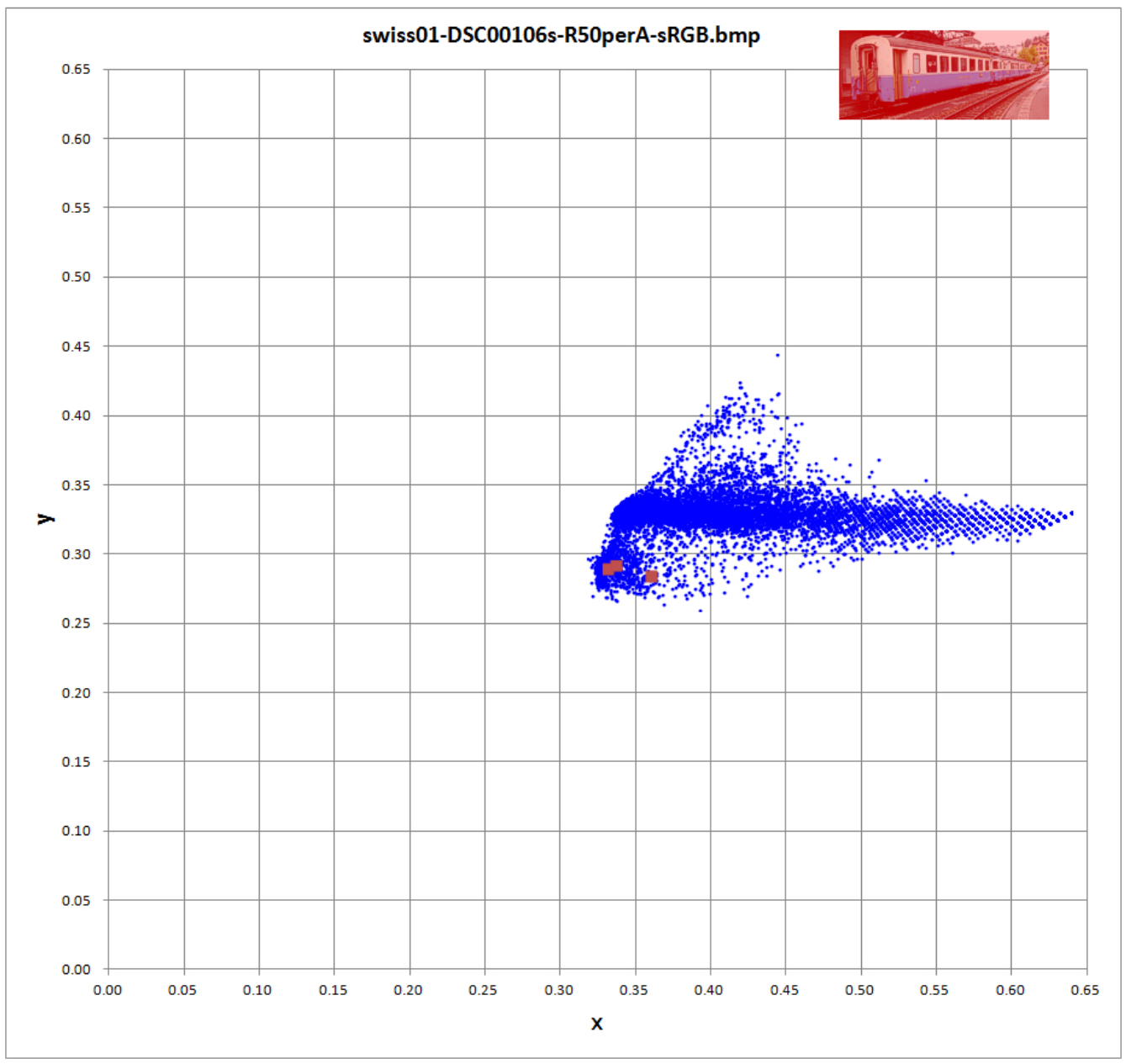
(red 50%)

(R, G, B) = (188, 68, 115)
(x, y) = (0.3600, 0.2846)

(R, G, B) = (188, 102, 154)
(x, y) = (0.3313, 0.2898)

(R, G, B) = (189, 98, 145)
(x, y) = (0.3369, 0.2923)

Red purple appears to be bluish.



Multiplicatively color-changed image

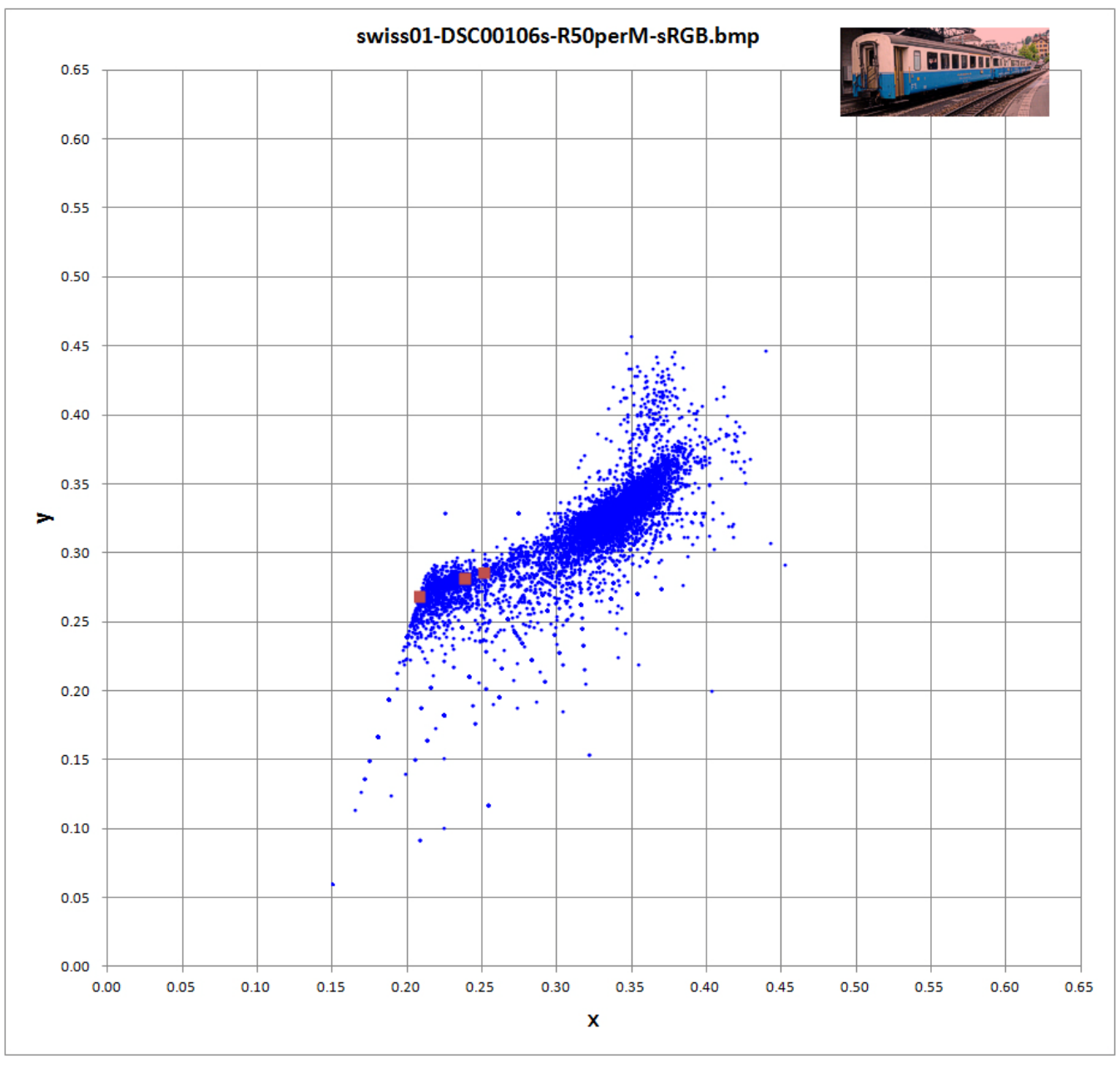
(red 50%)

(R, G, B) = (0, 68, 115)
(x, y) = (0.2054, 0.2595)

(R, G, B) = (21, 102, 154)
(x, y) = (0.2276, 0.2763)

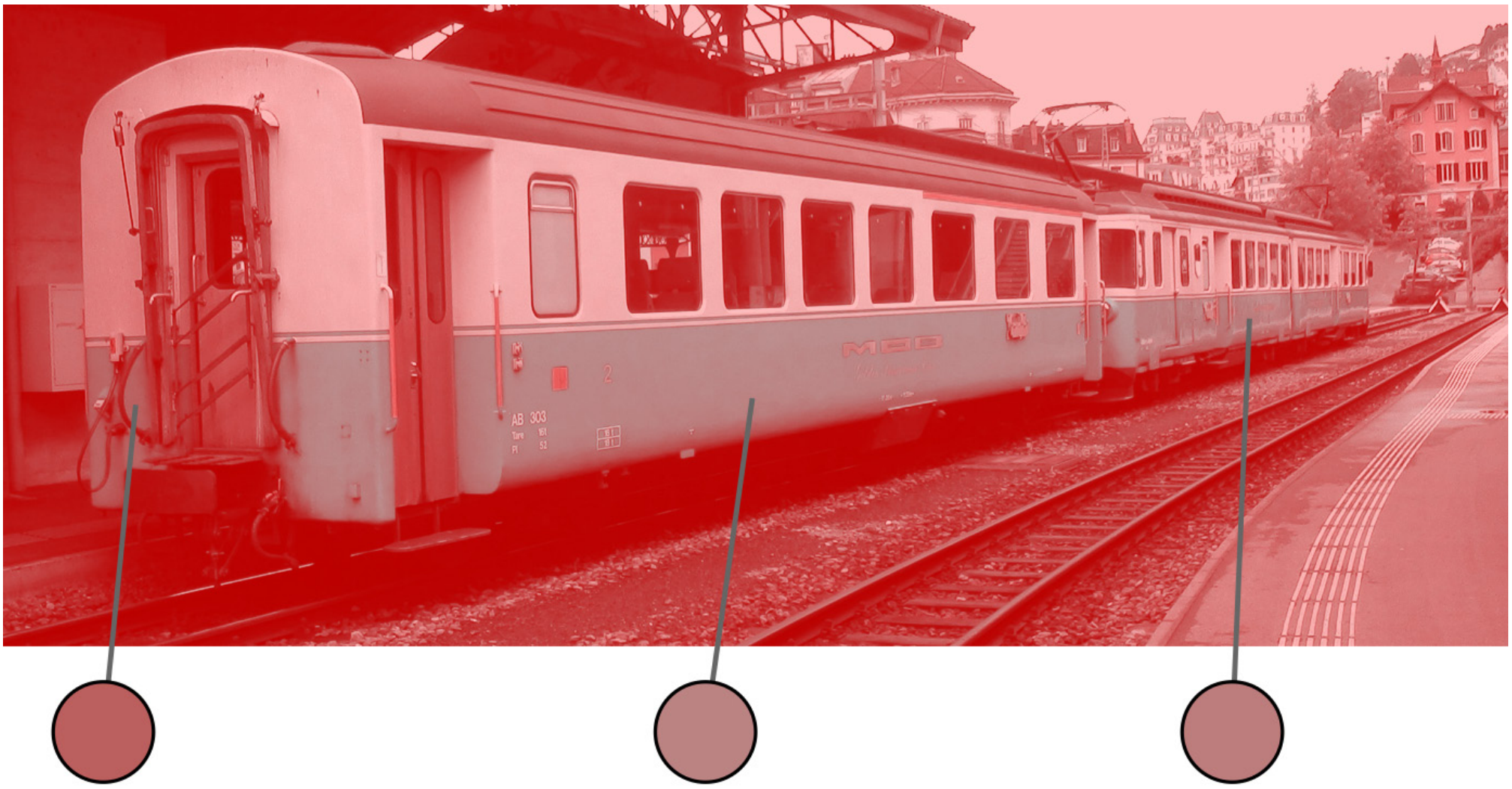
(R, G, B) = (37, 98, 145)
(x, y) = (0.2427, 0.2806)

Dark blue appears to be bluish. This demo is not regarded as color illusion because of the same hue.



Two-colored image (Two-colorization and additive color change)

(red 50%)

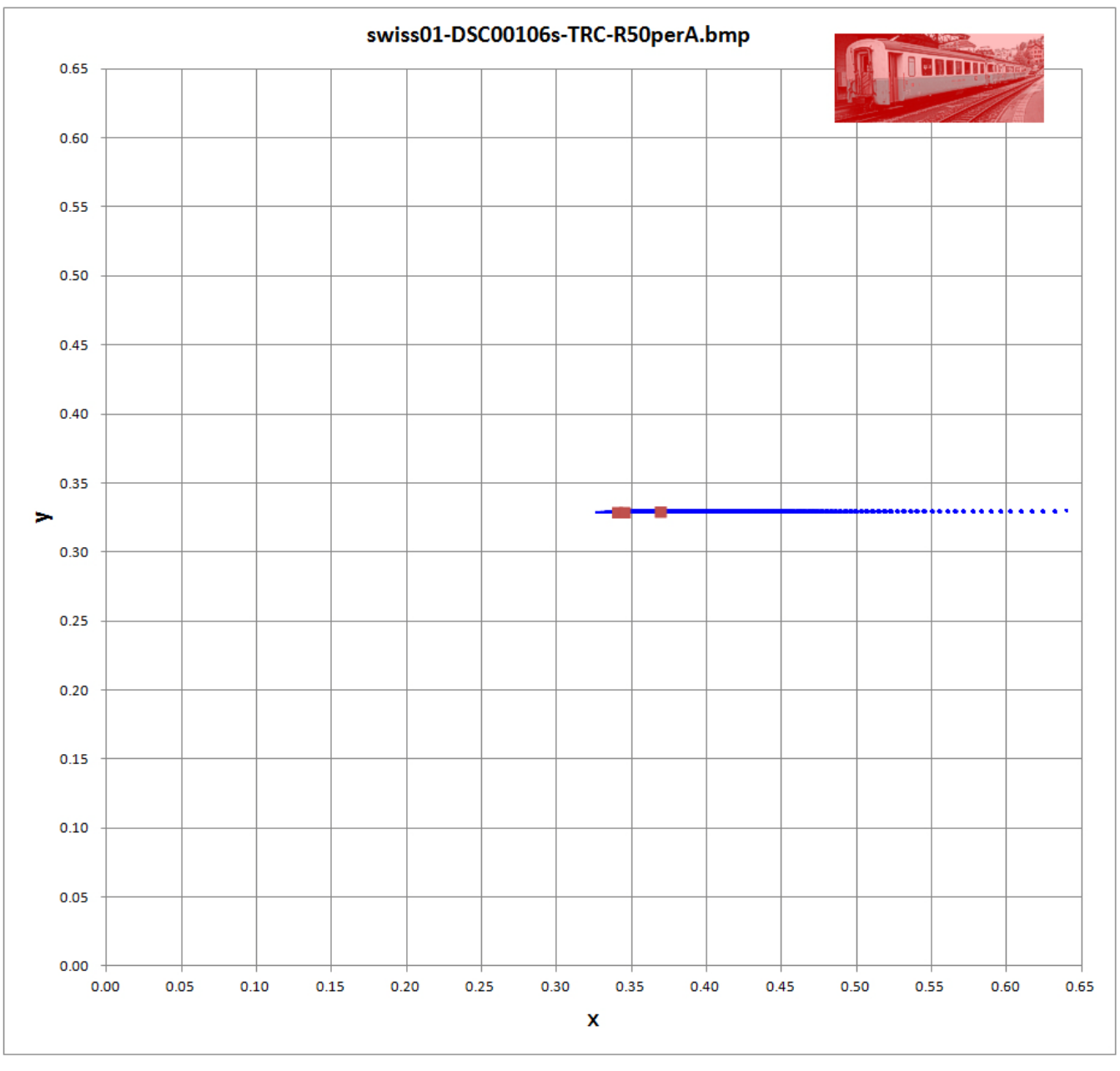


(R, G, B) = (188, 95, 95)
(x, y) = (0.3690, 0.3292)

(R, G, B) = (188, 131, 131)
(x, y) = (0.3404, 0.3291)

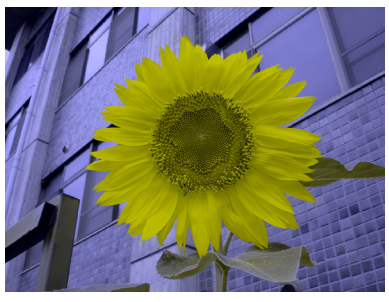
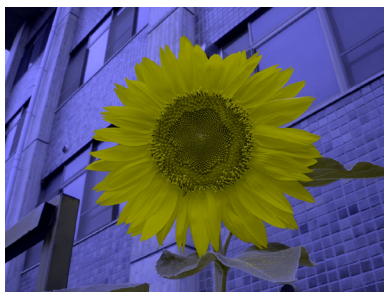
(R, G, B) = (189, 125, 125)
(x, y) = (0.3448, 0.3291)

Grayish red appears to be bluish.




Original image

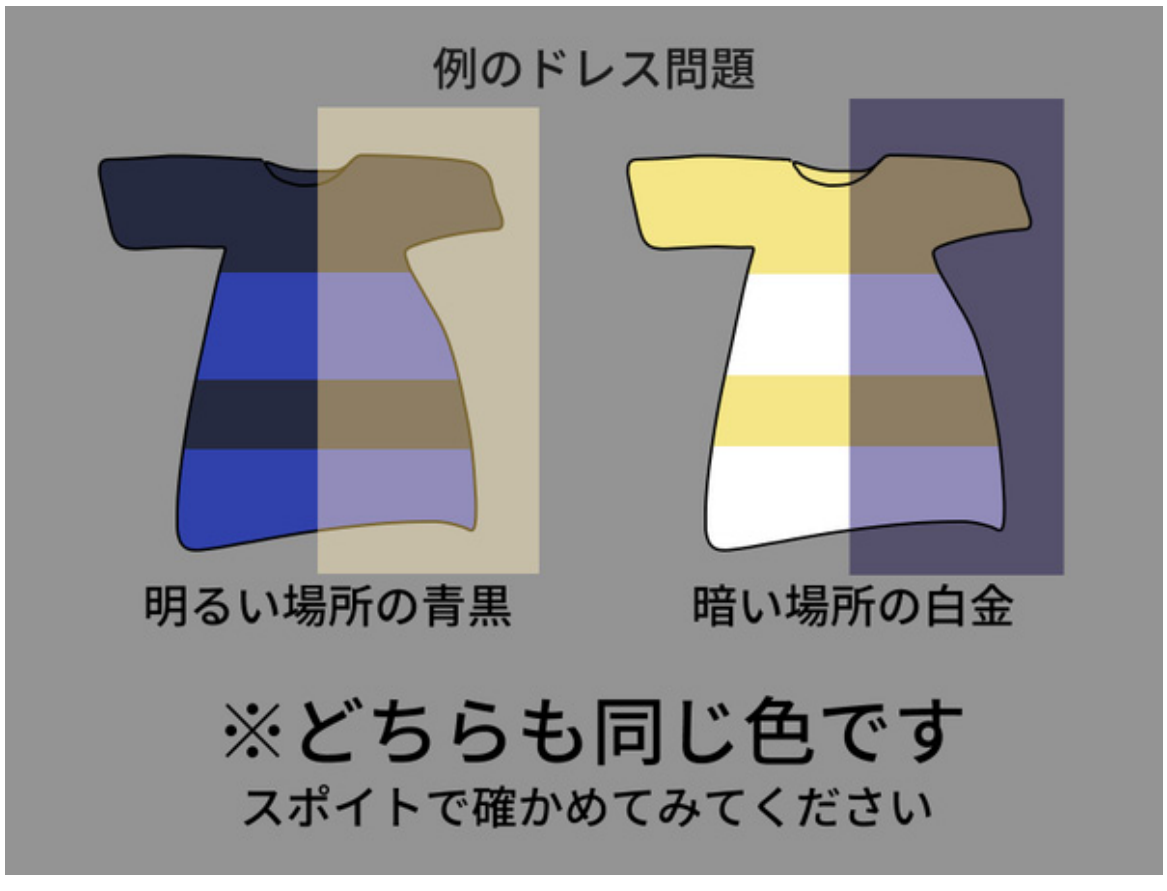
<Filtering color is blue>

	Multiplicative color change (giving transparent appearance)	Additive color change (giving translucent appearance)
Standard color changes	 50%  30%  10%  0% Petals appear be yellowish as they are (dark grayish yellow). No transmittance (0%) of red and green signals blacks out yellow.	 Petals appear be yellowish, though they are gray or of blue hue.
Land's two color method	 Petals appear be yellowish, though they are gray or of blue hue.	
Two colorization and color changes	 Two-colorized image  50%  30%  10%  0% Petals appear be yellowish as they are (dark grayish yellow). No transmittance (0%) of red and green signals blacks out yellow.	 Petals appear be yellowish, though they are gray or of blue hue.

Dress debate

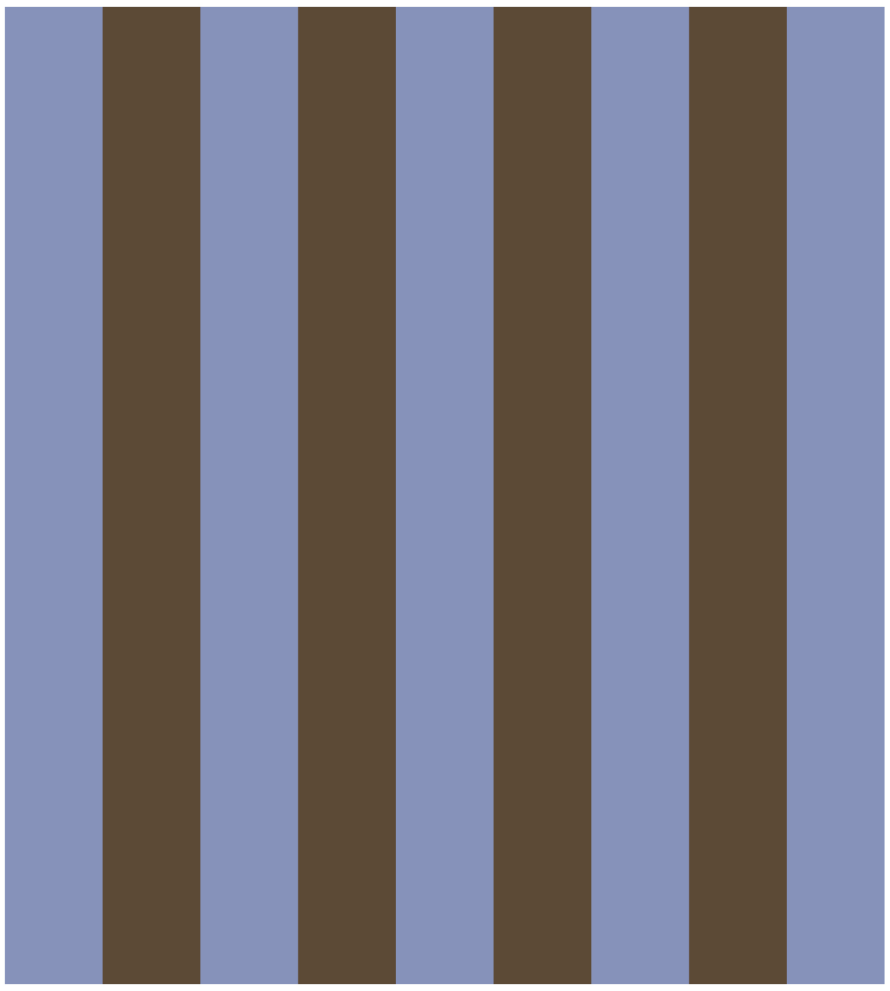
"Dress illusion" (February 2015) http://swiked.tumblr.com/post/112073818575/guys-please-help-me-is-this-dress-white-and

Ambiguity in the perceived color combination



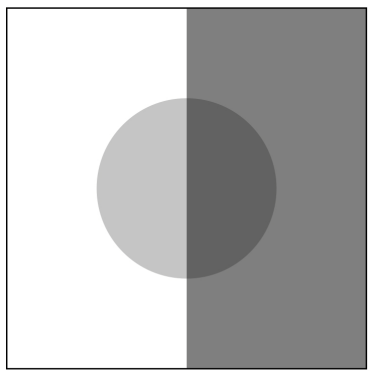
Explanation given by @budoucha (Twitter) (presented with permission)

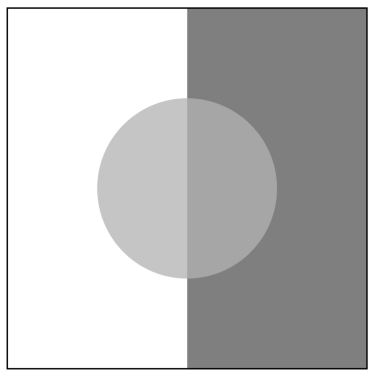
Many people see brown as black. How do you see this image?



bistable transparency

unique transparency



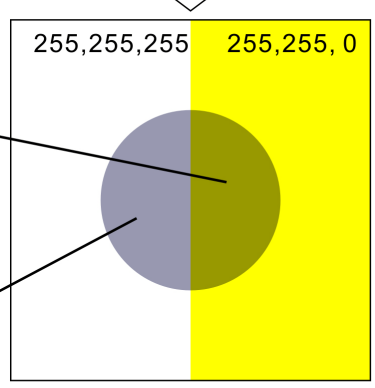


because no blue in yellow

RGB=152,152, 0

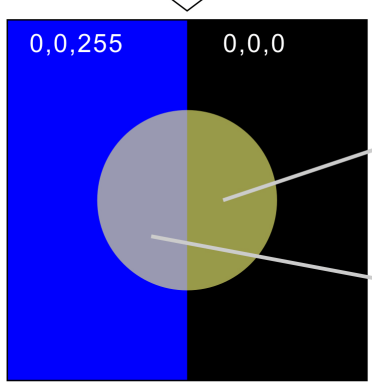
RGB=152,152,177

Produced yellow cannot be so dark as compared with produced blue.



multiplicative color change

cannot be the same



RGB=153,153,74

RGB=153,153, 177

Produced yellow cannot be so dark as compared with produced blue.

additive color change