Supplementary Methods online

Apparatus. The experiments were conducted in a chamber whose illumination was under computer control. Subjects were seated at a distance of 130 cm from the wall in front of the chamber. The monitor was placed in a tunnel 57 cm behind the wall, and was viewed through an opening of 10.6×8 deg. Stimuli were displayed on a Sony GDM-F520 CRT monitor with a spatial resolution of 800×600 pixels and refresh rate of 120 Hz, driven by a Cambridge Research VSG graphics card. The C.I.E. 1931 chromaticity of the white point of the monitor was x = 0.32, y = 0.34 with a luminance of 29 cd m^{-2}. Calibration of the setup is described in detail in Rinner & Gegenfurtner (2002).

Stimuli. Seven digitized photographs of fruit and vegetables were selected as stimuli due to their distinct object colour. Each stimulus contained one fruit object on a grey background. As control stimuli we used homogeneously coloured discs and noise discs with an amplitude spectrum resembling the average amplitude spectrum of natural scenes (1/f, pink noise). The stimuli were defined in the DKL colour space, which is spanned by a luminance axis (L + M) and two chromatic axes (L – M and S – (L + M)) that define the isoluminant plane (Derrington, Krauskopf & Lennie, 1984).

To change the colour of the stimuli, we first calculated cylindrical coordinates of each pixel in the original image, corresponding to their luminance, saturation, and hue. Saturation was defined as the vector length of the colour vector’s projection to the isoluminant plane. Hue was defined as the angle of the projection relative to the red direction of colour space. The azimuth q of the pixel with the largest saturation and the average saturation r were used to define a reference point $\mathbf{r} = (r, q)$ for the chromatic distribution. Subjects could adjust the whole distribution of colours in the two directions (L – M and (L + M) – S) by pressing corresponding buttons. After each key press, the difference in angle and amplitude were calculated between the reference point and the current setting. Then, the colour of every single pixel of the fruit was rotated according to the difference angle and scaled according to the ratio of the amplitudes. Let $\mathbf{r} = (r, q)$ be the reference point of the initial distribution in the isoluminant plane, given in polar coordinates, and let $\mathbf{r}' = (r', q')$ be the position of the new adjustment. Then, the chromaticities of all pixels $\mathbf{r}_i = (r_i, q_i)$ were adjusted to a new chromaticity position in the isoluminant plane according to $\mathbf{r}'_i = (r_i \frac{r'}{r},\ q_i + q - q')$. The luminance component of all pixels was left unchanged throughout the chromatic adjustment. The background colour was always grey. The fruit images had a mean luminance of 29 cd m^{-2} and an average root-mean-squared (rms) luminance contrast of 20%. Luminance of the disc used as control was 30.8 cd m^{-2}. The pink noise stimuli had an rms luminance contrast of 15% and a mean luminance of 29 cd m^{-2}. The size of the control stimuli and the average size of the fruit objects were 2×2 deg.

Procedure. One experimental run consisted of five presentations of each of the seven fruit objects in a randomised order. The subjects had two tasks that were run in separate blocks. In one task the subjects were instructed to adjust each fruit object to look grey, and in the other task the instruction was to set each fruit object to its typical colour. The order of the tasks was counterbalanced across subjects. The control experiment consisted of homogeneous discs and noise patches presented five times each in randomised order, and the subjects made only achromatic settings. The initial chromaticity of the stimuli was randomised on every trial. Subjects adjusted the chromaticity in the isoluminant plane by pressing four keys that corresponded to the L – M and the (L + M) – S axes. Subjects had unlimited time to make a setting. The setting, i.e., the current position of the reference point, was recorded by pressing a key, after which the next stimulus appeared.

Subjects. 14 subjects naïve to the purpose of the study participated in the experiments. All had normal or corrected to normal visual acuity and normal colour vision as tested with Ishihara colour plates.

Data analysis. The relationship between the magnitude and direction of the achromatic settings to the magnitude and direction of the typical settings were quantified in the following way: First, the achromatic setting for each fruit was projected on a line going through the typical setting and the achromatic setting for the control objects. The distance of this projected point from the control setting, divided by the distance of the typical setting from the control setting, was taken as an indicator of the strength of the memory colour effect. Formally, the memory colour index was computed as

$$m = \frac{\mathbf{a} \cdot -\mathbf{t}}{\|\mathbf{t}\|^2} ,$$

where $\mathbf{a}$ and $\mathbf{t}$ are the 2D vectors in the isoluminant plane for the achromatic and the typical setting of the fruits. Both vectors were defined relative to each observer's average achromatic setting of the control stimuli.

References

1. Rinner, O. & Gegenfurtner, K. R. Cone contributions to colour constancy. *Perception* **31**, 733-746 (2002).

2. Derrington, A. M., Krauskopf, J. & Lennie, P. Chromatic mechanisms in lateral geniculate nucleus of macaque. *Journal of Physiology* **357**, 241-265 (1984).