

Fluorescence thresholds for some reddish colours.

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Fluorescence is a well known characteristic of some materials which absorb electromagnetic waves at high frequency and re-emit them at a lower frequency. The correspondent visual impression is that the brightness of a surface is more luminous than it would be expected from the perceived illumination of the environment. This usually happens when the light source has a UV component in the non-visible part of the spectrum which increases the amount of visible radiation reflected by a fluorescent surface. Katz did not include fluorescence as a mode of appearance of colours, as his main distinction was between object and luminous colours. From the physical point of view his distinction would correspond to that between reflecting surfaces and self-luminous objects. On the other side fluorescent colours still appear reflecting surfaces, although unexpectedly bright; moreover the physical concepts of reflection and self-luminosity are inadequate to explain the visual characteristics of colours, as fluorescence involves re-emission, and self-luminous displays can often produce the impression of object colours. Evans was probably the first to perform a systematic study of fluorescent colours from a perceptual point of view, by examining how this impression depended on luminance relationships between different areas in the visual field. After his pioneering work the topic received little attention despite the increasing importance that fluorescent colours have in our daily life. This research aimed at finding the transition threshold between surface and fluorescent colours (by using the terminology by Evans), which would ideally correspond to the optimal colour surface beyond which colours are expected to assume a luminosity aspect. The NCS system appears particularly suitable for this purpose as its colour space contains all perceivable surface colours and its boundary separates them from the "non-surface" colours, i.e. colours which appear either fluorescent or luminous. In the first experiment the luminance threshold which separates the surface colours from a fluorescent patch in a chromatic Mondrian (appearing through an aperture of the same size of the other patches) was derived for four subjects by using the constant stimuli method. The luminance of the test patch was varied by changing the distance of an independent source of illumination; the test could be made of 7 different coloured papers, chosen from the theoretically zero blackness line of the Y70R hue (i.e. the colours closest to the boundary towards the luminous colours). In independent trials subjects had also to match the colour of the area test with the colour of another area of the Mondrian covered by the same paper, by manually adjusting the variable illumination of the test. Results show that fluorescence threshold is reached for all colours by increasing the luminance of the "surface" colour (i.e. that found by the matching procedure) of a rather constant amount; the average luminance difference is 0.124 Log units. The fluorescence luminance at threshold for all studied colours is increasing from the more to the less chromatic colour almost in parallel to the luminance of the correspondent surface colours, and interestingly is always lower than the luminance of the white. In a second experiment other two subjects found the fluorescence threshold for 7 of the previous 8 colours by using the method of limits. The independent illumination of the test was varied by using the same procedure as before, and each colour was observed against a white background, instead of a chromatic Mondrian. Results show that fluorescence threshold is reached at a higher luminance level as compared with that found in the previous experiment, but always lower than the luminance of the white, and the increase of luminance necessary to pass from surface to fluorescent colours depends on their chromaticness, being slightly higher for more chromatic colours. The average difference between the fluorescence threshold and the luminance of the paper illuminated at the same level of the white background (thus appearing as surface colour) is 0.182 Log units. These results will be compared with thresholds derived for different hues and other analogous studies involving the perception of different illuminations, and discussed in the frame of the anchoring theory of lightness perception proposed by Gilchrist.