Darkening ≠ dimming: Hue shifts under objective vs. subjective decrease in colour illuminance

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Objectively reducing the luminance of colour stimuli ('darkening') results in a hue shift, the Bezold-Brücke effect (e.g. Boynton and Gordon, 1965, Journal of the Optical Society of America 55, 78-86); this is accompanied by a shift in saturation (Bimler and Paramei, 2005, Journal of the Optical Society of America A, 22, 2120-2136). When colour stimuli are dimmed by adaptation to light rather than to dark (Jacobs and Gaylord, 1967, Vision Research, 7, 645-653), hue also varies, but it is not clear how far this parallel extends between 'darkening' and 'dimming' by adaptation change. Notably, the change to light adaptation may increase the saturation of hues by removing rod intrusion (Buck, Knight and Bechtold, 2000, Vision Research, 40, 3333-3344). This study presents a common framework for comparing outcomes of darkening vs. dimming. Data were obtained by applying the colour-naming method to monochromatic lights. The data allow the stimuli to be located in a spatial map where two dimensions stand for colour-opponent systems, whereas the changes in hue are reflected by angular displacements. We found that the pattern of hue shifts differs between the darkening and dimming conditions. Rather than a Bezold-Brücke effect, change in adaptation reveals an Abney effect: that is, the key influence on hue comes not from subjective stimulus intensity but from saturation. It follows that whatever non-linearity in the visual system allows colour dilution with white light to exert the Abney effect on hue, it is also invoked by adaptation changes. We compare the hue shift caused by 'dimming' to that produced by spatial luminance contrast (Bimler, Paramei and Izmailov, 2009, Journal of the Optical Society of America A, 29, 163-172).