

# SEEING AND FEELING CHANGES IN DAYLIGHT OVER TIME

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## Abstract

We see colour because light interacts with particles and surfaces and then with the sensors in our eyes. But the concept of colour arises from attributing colour to objects as an intrinsic property, and this operation requires disentangling changes in illumination over time and space from changes in object properties – the perceptual phenomenon of colour constancy. To what extent is colour constancy constrained by the properties of natural illumination, under which it evolved? Here I will describe physical measurements of the spatial and temporal characteristics of natural daylight, and psychophysical measurements of human visual discrimination of temporal changes in daylight metamers. The dynamics of daylight exhibit a characteristic tripartite pattern: for chromaticity, the periods of fastest change occur in early morning and late evening at the lowest irradiances, with an interim period of relative stability. Illuminance changes are generally smooth and fastest at the day's extremities, except when disrupted by weather. These changes in natural illumination are generally too slow to be directly detected. On the other hand, people are sensitive to the illumination "atmosphere", exhibiting strong preferences and memory for particular illumination chromaticities in behavioural tests, and effectively reading the intended time of day from chromaticity-luminance correlations in landscape paintings. Scene stability – a measure of colour constancy – is strongest for temporal changes in illumination chromaticity towards neutral. One speculation is that visual mechanisms dampen sensitivity to the largest natural changes in illumination chromaticity in order to maintain perceptual stability of object color. Conversely, nonvisual mechanisms appear tuned to chromaticity changes at dawn and dusk, and hence are critical for syncing the circadian clock with environmental conditions. The latter might also feed long-term memory of illumination conditions as well as subjective experiences of illumination atmosphere.