
Guest editorial

Contextual effects on colour appearance: Lightness and colour induction, transparency, and illumination

The papers in this special issue tell an elusive story. No plot might be discerned at first; no emergent structure beyond a plain sequence of interesting facts.

Yet there is a moment, possibly halfway through the story, when a revelation occurs and a filigree of obvious connections comes into existence. It is at this point that the reader realises that all the papers address a single problem: how regions in a visual scene are segregated, and thereby made sense of. The papers then become naturally grouped into three classes—depending on whether the boundaries on which such segregation relies seem to divide light from shadow (illumination), a see-through overlay from its surround in direct view (transparency), or a surface from surfaces nearby (lightness and colour induction).

1 Illumination

Classification of an edge as due to illumination, rather than to reflectance, permits the treatment of two or more regions of different colours as one. Three of the papers in this issue deal with the consequences this may have on some ‘immediate’ perceptual aspect of an object in a scene, such as its brightness (Schirillo and Shevell), colour (Jakobsson et al), and salience (Sun and Perona).

In the work of Sun and Perona, the simulated position (top-left or bottom-right) of the light source, in a scene that is shown very briefly, makes a target cube in the midst of a large number of identical cubes easier or harder to spot. The idea is that inferred illumination edges between the sides of the cubes (following the assumption that light comes from top-left) render them of a single reflectance, and this in turn provides a homogeneous background against which the dissimilar object stands out. In the variegated surroundings produced by the cubes when their edges seem to be due to reflectance changes, this facilitation effect vanishes. In the work of Jakobsson et al, an inferred illumination edge between the faces of a reversible object makes them appear as if having a single reflectance, but seen under a delicately coloured illumination, one face in the shadow and the other in light. This percept dissolves, and the single reflectance is replaced by two vivid surface colours, when a change in the apparent shape of the object transforms the shadow boundary in a reflectance edge. In the work of Schirillo and Shevell, an inferred illumination edge splits the scene into two differently illuminated regions, and this causes a small patch lying in the shadow to appear less bright than an equal patch placed on an equal immediate surround, in a scene that contains perceptual reflectance edges only.

2 Transparency

A surface that is seen both in plain view and through a transparent overlay is identified as a single surface, even though its luminance or colour are not uniform all over. This is a remarkable variation on the same general theme, the grouping of disparate features to obtain one. Grouping is obtained by separating: in this case, the colour properties of a filter must be separated from the colour properties of the underlying surface, much as the colour properties of the light, or shadow, falling on rocks and trees must be separated from the colour properties of the rocks and the trees. Kingdom et al present a work which may be regarded as complementary to Schirillo and Shevell’s, the crucial difference being that the phenomenal dark veil under which the patch of

interest lies looks like a transparent filter, rather than a shadow. The patch seems brighter than one which is not seen as behind a filter, though the two patches are actually identical and shown against identical immediate surrounds. The fact that these two papers appear to report opposite results will not go unnoticed. One may restate the point by saying that in Schirillo and Shevell's experiment observers are taking the illuminant into account, rather than discounting it as they do in Kingdom et al's.

In the latter case, as in the double illusion presented by Jakobsson et al, the problem of segmenting the scene into different surfaces and the light that bathes them, or the filter that covers them, is solved by extracting a common component that is attributed to illumination, or to the overlay; but things are not always that simple. Imagine a multicolour background with a round filter on it, such that it turns the brownish regions underneath into the most diverse shades of green, blue, orange, and pink. While conversions are consistent locally, globally they are not, meaning that no common component can be assigned to the overlay. Such a filter (which belongs to the family of 'impossible figures' no less than the Penrose triangle) is surely not an object of this world, yet it is perceptually as distinct as a piece of plain tinted glass. The picture that portrays it is a fragment of an ostensive definition of colour transparency in D'Zmura et al's contribution—and one that, from the standpoint of the detection-and-separation algorithm these authors discuss, represents both a success and a challenge: a nonhomogeneous transparent overlay like this can be detected, but not separated from the underlying surfaces.

3 Lightness and colour induction

In scenes that contain an apparent illumination (or transparency) component, the perceived reflectance of a surface is separable from its perceived luminance. This does not apply to the most familiar instances of colour induction, such as simultaneous contrast, where identical patches lie on different surrounds, and edges might be seen as the result of a change in illumination, or reflectance, or both. In these cases the interest of investigators is not so much on the distinction—or interplay—between the perceptual attributes of lightness, brightness, and illumination as on the nature and strength of the induction effects. Of the ensuing papers, two fall into this class. One (Shepherd) is a study of colour contrast in simulated coloured shadows, where a neutral region appears tinged with a hue complementary to that of its surround. Indeed, coloured shadows do contain an illumination component, but, if anything, this appears to make the illusory hue stronger than in ordinary colour contrast. The other (Spehar et al) describes a second-order version of White's effect where the various regions are filled with contrast variations and differ in the amount of such contrast; and shows that the perceptual outcome goes in the same direction as in the traditional luminance version.

The story of White's effect reminds one of the man who having won the lottery finds that his family tree has enlarged to include lots of unsuspected uncles and cousins. Some of these are certainly entitled to claims of consanguinity. White's effect was described by White in 1979, but colour versions of it had been reported by Gindy in 1963, Wright in 1969, and Munker in 1970 (all cited in Todorović's paper, in this issue). Gindy's and Munker's were dissertations, but the work by Wright was a book, and the figure, a quadripartite composition of red and cyan squares on yellow and dark purple stripes, appeared on its cover. As to the achromatic effect, many feel that its resemblance to the old Benary cross is not accidental, and the authors of the three remaining pieces—Todorović, Zaidi et al, and Anderson—are among these. Here the concern is not with the apparent cause of edges, but with their geometry; or more exactly, with the way they come together and give rise to junctions. Each bearing partly different fruits, these three papers grow out of the same observation: when three abutting

regions of different luminances form a T-shaped junction, contrast occurs predominantly between the regions that share the stem, rather than the top, of the T.

In nature, T-junctions (in any orientation) are likely to indicate that the region at the top of the T is either an occluding surface (such as a hillcrest that partially hides the distant trees of a forest) or a faraway surround (such as the sky beyond a progression of cultivated fields). An increased discriminability between objects and their nearest backgrounds (areas separated by stems of Ts) can be put to greater use than an increased discriminability between these objects and close-up hills, or backdrop skies (separated by tops of Ts). A nonobvious conclusion that both Todorović and Zaidi et al arrive at—the former by argument and the latter by experiment—is, however, that such effects obtain *irrespective* of any three-dimensional interpretation and independently of perceptual inferences of coplanarity or belongingness. In other words, the dark tree trunks do not need to be phenomenally soaring against the vegetation to make it appear, by simultaneous contrast, a lighter shade of green; nor must the hill be seen as closer than the rest of the scene, or as blocking the view, to remain chromatically inert. The rule is embodied in some relatively ‘dumb’ mechanism and applies even when depth cues indicate otherwise. Todorović goes on to show that an extension of this rule to 4-way junctions in which only two edges are collinear (something shaped like a cross with one bent arm) can account for some apparently more complicated lightness effects, such as Adelson’s corrugated mondrian, without calling into play the perceived presence of shadows or filters.

Anderson’s contribution bears some initial resemblance to the above papers in its concern with contour junctions, but departs from them in two important aspects: its specific attention to the luminance relationships that arise at such junctions, and the insertion of an intermediary between the geophotometric input and the perceptual output. The rule in the machine here is: when the two regions that share the stem of the T both represent an increment (or a decrement) in luminance with respect to the region at the top, the region for which this increment (or decrement) is smaller is decomposed into two layers. Although no less dumb than the one discussed above, such a mechanism sifts (through a smaller hole) a larger world: any two polarity-preserving aligned contours will do, whether the stem of the T is stretched across the top (X-junctions) or contracted so much as to lose its property of having an orientation (I-junctions). Scission can parade under the form of a transparent overlay, or a neon colour spreading veil; or disclose itself secondhand as a lightness change.

This last piece calls on stage all the topics of this first special issue (lightness and colour induction, transparency, and illumination) and introduces neon colour spreading and illusory surfaces, that will be performing together, with and without the supporting role of motion, in the forthcoming second special issue. If this collection of papers has a moral, one feels it would have to do with the role of edges in vision. This editorial began with the effects of the interpretation of edges on colour appearance, and ended with their geometry. The descriptive force (and occasional frailty) of these two themes appears and reappears through these works—bringing on the fertile mixture of pleasure and doubt that preludes the forming of new ideas.

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