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Continuing Commentary

Commentary on **Alex Byrne & David R. Hilbert (2003). Color realism and color science. BBS 26(1):3–21.**

Abstract of the original article: The target article is an attempt to make some progress on the problem of color realism. Are objects colored? And what is the nature of the color properties? We defend the view that physical objects (for instance, tomatoes, radishes, and rubies) are colored, and that colors are physical properties, specifically, types of reflectance. This is probably a minority opinion, at least among color scientists. Textbooks frequently claim that physical objects are not colored, and that the colors are "subjective" or "in the mind." The article has two other purposes: First, to introduce an interdisciplinary audience to some distinctively philosophical tools that are useful in tackling the problem of color realism and, second, to clarify the various positions and central arguments in the debate.

The first part explains the problem of color realism and makes some useful distinctions. These distinctions are then used to expose various confusions that often prevent people from seeing that the issues are genuine and difficult, and that the problem of color realism ought to be of interest to anyone working in the field of color science. The second part explains the various leading answers to the problem of color realism, and (briefly) argues that all views other than our own have serious difficulties or are unmotivated. The third part explains and motivates our own view, that colors are types of reflectances, and defends it against objections made in the recent literature that are often taken as fatal.

Colors as explainers?

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Abstract: Byrne & Hilbert (B&H) argue that colors are reflectance properties of objects. They also claim that a necessary condition for something's being a color is that it causally explain – or be causally implicated in the explanation of – our perceptions of color. I argue that these two positions are in conflict.

Byrne & Hilbert (2003; henceforth B&H) argue for reflectance physicalism, the view that colors are reflectance properties of objects. A necessary condition for something's being a color, in their opinion, is that it should causally explain – or be causally implicated in the explanation of – our perceptions of color.[1] Their view is that "[a]ny plausible version of physicalism will identify the colors with physical properties implicated in the causal process that underlies the perception of color" (sect. 3.1). So, according to B&H, if I come to believe that there is a red object in front of me, the color of that object must causally explain my perceptual belief that the object is red. Call this the *Causal Explanation Condition.*

The problem of metamerism is that quite different reflectance properties, given suitable illumination, can match in color. This is a problem for reflectance physicalism because it strongly suggests that color cannot be identified with any specific reflectance property. In response to this problem, B&H suggest that we would do better to identify colors with "reflectance-type*s* (or sets of reflectances) rather than with the specific reflectances themselves" (sect. 3.1.1).[2]

Let us suppose that R1, R2, and R3 are reflectances that match in color – say red – under some suitable illumination. Then, according to B&H, the color red is to be identified with the set {R1, R2, R3}. Let us also suppose that I am looking at an object O, the surface of which has reflectance property R2, and that as a result I come to believe that O is red. It might be thought that on B&H's view O's color is what causally explains my perceptual belief that O is red. But appearances can be deceiving. For what property causally explains my perception of redness? Arguably R2. After all, since that is the reflectance property that O has, on B&H's view that must be the property of O that causally explains my perception of red. But according to B&H, R2 is not the color red; rather, the color red is the set {R1, R2, R3}. So it seems that if the color red is identified with a set of reflectance properties, then the color red cannot be what causally explains our perceptions of redness. So given the Causal Explanation Condition, the color red cannot be identified with a set of reflectances. Similar remarks apply to the other colors.[3]

Objection: If O has the reflectance property R2, then trivially O has either R1 or R2 or R3, and so trivially O is red. So if O has R2, then the color red does causally explain my perceptual belief that O is red. But this won't do. For consider: If O has reflectance property R2, then trivially it has either R2 or B1 or B3 – where B1 and B3 are, we shall suppose, the unique reflectance properties that match with respect to the color blue under suitable illumination – and so trivially is *red or blue.* So, if O has R2, then the color red or blue causally explains my perceptual belief that O is red. But this is false. It is not O's having the color red or blue that causally explains my perceptual belief that O is red; it's O's having the color red. So the preceding argument for the claim that the color red causally explains my perception of redness must be rejected.

Suppose, then, we opt instead for the view that colors are reflectance types rather than sets of reflectances. Then, if the color red is identified with the property of having some reflectance property that plays a certain specified role – call it the "R-role" – in the production of perceptual beliefs about redness it might be thought that the present objection fails. But again, suppose I am looking at an object, the surface of which has reflectance property R2, and I thereby come to believe that the object is red. What property causally explains my perception of redness? Again, arguably, it is R2. But on the present proposal we have:

1. The color red = the property of having some reflectance property that plays the R-role.

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2. R2 = a reflectance property that plays the R-role

So again, R2 is not the color red. But if what causes my perceptions of redness is R2, then once more, the color red fails to cause my perceptions of redness. So again, given the Causal Explanation Condition, the color red cannot be identified with a reflectance type.

It might be thought that there is an easy way around these objections. Say that an object O's color causally explains our perception of color at a time *t* if, first, O has one of the properties in the relevant set of reflectances – or a property playing the appropriate role – and second, that this particular reflectance property causally explains our perception of color at *t.* And take our object O again. By hypothesis, O has the reflectance property R2. And we are assuming that R2 causally explains our perception of redness at *t.* So it might seem that O's color – namely, red – causally explains our perception of redness after all. What is wrong with this view?

What is wrong is that whatever else R2 is, it isn't the color red, at least not on B&H's view. So it is hard to see how it can be the case *both* that R2 is what causally explains our perceptions of redness at *t, and* that the color red is what causally explains our perceptions of redness at *t.* We can certainly say, of course, that O appears to be red because it has the reflectance property R2, but this is not the same as saying that O appears to be red because it is red.

The upshot is that B&H's identification of colors with sets of reflectance properties, or types of reflectances, sits badly with the Causal Explanation Condition. If B&H insist that colors are sets of reflectance properties, then it isn't clear that colors can causally explain perceptual beliefs about color. And if B&H insist that colors must causally explain perceptual beliefs about color, then it isn't clear that colors can be identified with sets of reflectance properties.

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NOTES

1. There is clearly a difference between the concept of causal explanation and that of causal implication. For while it is true that, if X causally explains Y, then X is causally implicated in the explanation of Y, the converse fails: X could be causally implicated in the explanation of Y without causally explaining Y. For ease of exposition, however, I will simply talk about causal explanation in what follows. What I say about causal explanation applies to causal implication as well.

2. Although it is not clear to me whether B&H intend these to be distinct claims, for present purposes I will treat them separately.

3. This sort of worry is by no means unique to philosophical discussions of color. To take a familiar example, some philosophers of mind hold the view that the property of being in pain is a disjunctive property. In humans, the property of being in pain is the physical property Ph; in dogs, the physical property Pd; in Martians, the physical property Pm; and so on. So pain turns out to be the disjunctive property Ph or Pd or Pm, or the set {Ph, Pd, Pm}. And the causal worry remains: It is not my being in pain that is causing my headache, but my having Ph. For more on this sort of worry see the papers collected in Kim (1993).

Do opponent process theories help physicalism about color?

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Abstract: Byrne & Hilbert (B&H) give some excellent replies to the objections to realism about color. However, the particular form of realism they propose, based on opponent processing, prompts several challenges. Why characterize a color by its tendency to produce an intermediate brain signal, rather than in terms of the final effect – either a perception or a neural substrate for it? At the level of the retina, and even of the cortex, there are processes that partly parallel the structure of color experience; but the correspondence is not exact. Must we assume that there is any place in the brain where an exact structural correspondence is found? At the level of psychophysical functioning, there is indeed opponency; but it is not clear that this gives us the kind of type-reduction that B&H want.

Byrne & Hilbert (2003; henceforth B&H) want to use opponent process theory to provide an answer to the question "what is redness?," in such a way as to make it easy to respond to some standard challenges to physicalist reductions of color. One important challenge is that these reductions cannot properly capture such facts as "purple is more similar to blue than to green," because the physical correlate for purple might well not be physically more similar to the physical correlate for blue than it is to the physical correlate for green. Another challenge is that reductions do not capture the structure of colors, or, for example, the fact that red is a unique hue and orange is not; for there's surely no sense in which (the physical correlate for) orange is, in physical terms, composite, whereas (the correlate for) red is not.

B&H do excellent work, I think, in clearing the ground for a realist view of color. But I am not sure that once the objections are removed, the kind of physicalist reduction they propose is going to work. My concerns are basically these: In the retina and beyond, there is plenty of evidence of some kind of physiological opponent processing. If we follow one recent report (Dacey & Lee 1999), midget bipolar cells show something like (+R -G) opponency in the form of an (L-M) signal; and the bistratified ganglion cells show something like (+B -Y) opponency in the form of an S-(L+M) signal. However, no one thinks that these cells constitute the seat of visual consciousness; and only a little reflection shows that the exact form of these signal functions does not correspond at all exactly to the perception of redness versus greenness and the perception of blueness versus yellowness. (In particular, a simple (L-M) signal will never be significantly positive in the violet part of the spectrum – whereas of course the violet hues are actually seen as reddish. One solution would be to have some negative input from S cones to the (+R -G) function; but this has not, I think, been reported in the physiology of the retina.) What is more, it would be more or less make-believe to suppose that the actual weights on the L, M, and S inputs to the opponent processes in post-retinal coding are such as to yield functions reaching their maxima and minima at just the points where perceivers register maximum degrees of redness and other unique hues.

There is a form of opponent process theory that is in much more direct correspondence with perceptual experience: The one developed by Hurvich and Jameson (1955; cf. also Jameson & Hurvich 1955). But their chromatic response functions are contributions to psychophysics, not physiology; they describe the performance of human subjects performing a hue-cancellation task – mixing with sample lights varying quantities of standard lights (red or green, yellow or blue), in order to cancel any appearance in the sample of the complementary hue (i.e., green or red, blue or yellow).

The details of this theory are interesting. But it is questionable whether it provides much help to the kind of physicalism B&H seem to want to support. Suppose we take it that reddishness is that kind of reflectivity which gives rise to "reddish" reactions (i.e., to a positive value of the (+R -G) function). Is this any better than saying that reddishness is that kind of reflectivity which gives rise to experiences of reddishness? After all, what Hurvich and Jameson effectively mean by saying that a light has a positive value on the (+R -G) function is that it needs some green to be mixed with it in order to lose its appearance of reddishness. The "chromatic response functions" simply record where an appearance of reddishness (and so on) is found, and how much of a complementary color is needed to cancel it; they don't tell us what the reddishness, or the experience of it, consists in.[1] One might perhaps take the Hurvich and Jameson chromatic response functions as actual descriptions of the output of physiological processes somewhere in the brain; but then one would be committed to finding, not processes with an output something like (L-M) and (L+M)-S (as is plausible), but instead processes with the outputs 1.6645L −