# HARDIN, TYE, AND COLOR PHYSICALISM

Larry Hardin has been the most steadfast and influential critic of physicalist theories of color over the last 20 years. In their modern form these theories originated with the work of Smart and Armstrong in the 1960s and 1970s[1] and Hardin appropriately concentrated on their views in his initial critique of physicalism.[2] In his most recent contribution to this project[3] he attacks Michael Tye's recent attempts to defend and extend color physicalism.[4] Like Byrne and Hilbert[5], Tye identifies color with the reflecting properties of objects ("reflectance physicalism"). Specifically, the determinate and determinable colors are identified with types of reflectances. (Setting some complications aside, the reflectance of an object is the proportion of light that it reflects at each wavelength in the visible spectrum.) These reflectance types are, in the terminology of Hilbert, *anthropocentric*—in the terminology of Lewis[6], they are not very "natural"

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[1] D. M. Armstrong, *A Materialist Theory of the Mind* (New York: Humanities Press, 1968), *Perception and the Physical World* (New York: Routledge & Kegan Paul, 1961); J. J. C. Smart, "On Some Criticisms of a Physicalist Theory of Colors," in *Philosophical Aspects of the Mind-Body Problem*, ed. C.-y. Cheng (Honolulu: University Press of Hawaii, 1975).

[2] "Are "Scientific" Objects Coloured?," *Mind* 93 (1984): 491-500, "A New Look at Color," *American Philosophical Quarterly* 21 (1984): 125-34, *Color for Philosophers: Unweaving the Rainbow*, 1 ed. (Indianapolis: Hackett, 1988).

[3] "A Spectral Reflectance Doth Not a Color Make," this JOURNAL, 100, no. 4 (2003): 191-202.

[4] *Consciousness, Color, and Content* (Cambridge, MA: MIT Press, 2000). See also P. Bradley and M. Tye, "Of Colors, Kestrels, Caterpillars, and Leaves," this JOURNAL, 98, no. 9 (2001): 469-87.

[5] D. R. Hilbert, *Color and Color Perception: A Study in Anthropocentric Realism* (Stanford: CSLI, 1987); A. Byrne and D. R. Hilbert, "Colors and Reflectances," in *Readings on Color, Volume 1: The Philosophy of Color*, ed. A. Byrne and D. R. Hilbert (Cambridge, MA: MIT Press, 1997).

[6] "New Work for a Theory of Universals," *Australasian Journal of Philosophy* 75 (1983): 343-77.

properties—but whether objects have them does not depend in any interesting way on perceivers.

Although the focus is on Tye's position, Hardin's objections are clearly intended to apply to other versions of reflectance physicalism.[7] However, as we shall argue below, Hardin's objections to reflectance physicalism in general are unsuccessful.

First, a remark on the dialectical situation. Hardin apparently takes for granted that reflectance physicalism has some independent motivation, and that the onus is largely on its critics to undermine it. However, he sometimes suggests that it is question begging to assume the truth of reflectance physicalism in replying to objections to it. For example, in discussing Tye's comparison of color illusions with shape illusions Hardin claims that there is a crucial difference between the two, namely that there is no way to measure color independently of perception while such methods do exist for spatial properties. The reflectance physicalist will reply that it *is* possible to measure reflectance—and so color—independently of perception. Hardin dismisses this reply, saying it assumes that "we already know that spectral reflectances are colors, and that is, once again, the point at issue."[8] But this runs together two kinds of arguments. If Tye's comparison with shape were being offered as part of an argument for the truth of reflectance physicalism then it would be question begging to assume at the outset that colors are reflectances. In the case in question, however, Hardin has claimed that reflectance physicalism is incompatible with certain facts about color appearances (see section I below). Obviously, assuming the truth of a theory is a bad way to argue for it; equally obviously, it is an essential part of

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[7] See A. Byrne and D. R. Hilbert, "Color Realism and Color Science," *Behavioral and Brain Sciences* 26 (2003): 3-21, "Colors and Reflectances," op. cit.

[88] Hardin, op. cit., p. 195.

showing the theory's compatibility with the empirical data. In what follows, we are merely trying to do the latter; we are not giving any positive argument for reflectance physicalism.

Second, a remark on the scope of Hardin's arguments. Although Hardin's official target is reflectance physicalism, his three objections are more inclusive. For example, the first objection (see section I below) is in fact directed against any theory of color that holds that an object's color typically does not depend on the colors of surrounding objects, and reflectance physicalism is just one such theory. The other objections are likewise directed at (different) broader targets. However, for simplicity we will largely ignore these complications.

Now to Hardin's objections.

## I. CONTRAST

As Hardin nicely describes, the apparent color of an area of a scene depends not only on the physical characteristics of that area but also on the characteristics of the rest of the scene. One kind of dependency is illustrated by simultaneous contrast: the apparent color of a target area varies with changes in the surround.[9] Contrast effects are sometimes taken to motivate the view that an object has a color only relative to its surround.[10] Although a physicalist about color could endorse this, a *reflectance* physicalist could not, because the reflectance of an object is independent of its surround.

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[9] It is worth observing that many changes in background will produce little or no change in the perceived color of a target. Contrast effects are largest for very simple scenes involving backgrounds that are either highly saturated, very light, or very dark.

[10] See J. Cohen, "Color Properties and Color Ascriptions: A Relationalist Manifesto," available from http://aardvark.ucsd.edu/~joncohen/color/relational.html; B. P. McLaughlin, "The Place of Color in Nature," in *Colour Perception: From Light to Object*, ed. R. Mausfeld and D. Heyer (Oxford: Oxford University Press, 2003).

However, Tye's comparison of color contrast with some well-known illusions of spatial perception explains why contrast poses no threat to reflectance physicalism.[11] Illusions such as the Müller-Lyer illusion do not show that the length of an object is relative to its surround. Rather, they show that sometimes an object's surround can prevent us from seeing the length it actually has. Similarly, although often square objects look square, sometimes they do not, for example when a square is superimposed on one side of a pattern of radiating spokes it looks wider at one end than at the other.[12]

Here it is helpful to draw a distinction between *perceptible properties*, on the one hand, and *conditions necessary for their perception*, on the other.[13] The two should not be confused, any more than the pressure of one's bicycle tires should be confused with the conditions necessary for detecting the pressure (the presence of a well-functioning pressure gauge, among other things). The conditions necessary for the (veridical) perception of shape include facts about the surround, and also facts about the perceiver. Plainly this does not show that shape itself—the property perceived—is in any way relative to the surround, or relative to the perceiver, or that no external object has a shape. Similarly, the conditions necessary for the perception of color include facts about the surround, and also facts about "mechanisms within the brain of the viewer."[14] But this does not show that color is relative to the surround, or to the perceiver, or that no external object has a color.[15]

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[11] Tye, op. cit., pp. 153-55.
[12] As illustrated by Tye's figure 7.3 (ibid., p. 154).
[13] See Byrne and Hilbert, "Color Realism and Color Science," op. cit., p. 6.
[14] Hardin, op. cit., p. 7.
[15] See Hilbert, op. cit., pp. 66-68.

Likewise, the fact that the apparent color of an object depends on its surround does not show that we always misperceive the object's real color. Tye, however, suggests that any influence of the background on perceived color generates a color illusion. According to Tye, "the colors things are *experienced* as having as a result of the contrast between the real color of the stimulus and the real color of the background are merely apparent…Our experiences represent them as being instantiated when in reality they are not…contrast effects involve color illusions."[16] Tye here seems to be assuming that for veridical perception of color the apparent color of an object must not depend in any way on the reflecting characteristics of other objects in the scene. The problems with this view are many, as Hardin forcefully points out.[17] Fortunately for reflectance physicalism it is based on a misconception: for some colors, a certain kind of surround may simply be a condition necessary for their (veridical) perception.

But why is the surround important to the perception of color? Hardin himself has lucidly outlined an explanation of this in the opening part of his paper. The light reaching the eye from an object—the color signal—is the product of the reflectance of the object and the spectral power distribution of the illuminant. Even if we ignore the loss of information due to the small number of types of photoreceptors in the eye, the problem of estimating the reflectance of the object is still seriously underconstrained. Focusing on the achromatic colors for simplicity, a given color signal might be produced by white object in dim illumination, a gray object in medium illumination, or a black object in

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[16] Tye, op. cit., p. 156.

[17] In addition, Tye's assumption is in some tension with other elements of his discussion, namely the emphasis on the relative illumination-independence of apparent color. For reasons given by Hardin and discussed by us below, color constancy requires that the visual system make use of information about scene features other than the reflectance of the target object.

bright illumination. Faced with this problem, the visual system employs various built-in heuristics: adaptation, and the use of information and assumptions about other objects in the scene before the eyes. One such assumption might be that the object reflecting the greatest amount of light is white, and that gray and black objects reflect certain fixed proportions of this amount—the darker the object, the smaller the proportion. It is not hard to see why, given these sorts of heuristics, the visual system would fail to detect that an object was black unless other lighter objects were in the scene.

One more remark before we leave the phenomenon of simultaneous contrast. The following line of reasoning might seem superficially cogent: nothing is black, because the visual experience of black always involves the "illusory" mechanism of simultaneous contrast. But this is a mistake. *Visual mechanisms* (for example, the mechanism of simultaneous contrast) are neither illusory nor veridical. Rather, it is the *output* of visual mechanisms—visual experiences—that are illusory or veridical. The same mechanism may produce illusory output on one occasion, and veridical output on another.

## II. UNIQUE AND BINARY HUES

Hardin's next objection turns on the distinction between unique and binary hues.[18] There is a shade of green ("unique green") that is neither yellowish nor bluish, and similarly for the three other *unique hues*—red, yellow, and blue. In contrast, every shade of purple is a bit reddish and a bit bluish, and every shade of orange is a bit reddish and a bit yellowish. Purple and orange are accordingly *binary* hues. Hardin claims that "the unique-binary

[18] In Hardin's paper (op. cit.), this is advertised as "The last major objection" (p. 198). As explained in section III below, this is somewhat misleading.

structure of the hues is essential to them and is not properly captured by any reflectance-based theory of colors."[19]

This objection is certainly suggestive, but what exactly is it? Of course, there is a sense in which the reflectance physicalist can easily divide reflectance types into those that are unique, and those that are binary. The reflectance types that are unique are the ones identical to red, yellow, green and blue; those that are binary are the ones identical to purple, orange, olive, and turquoise. Hardin, obviously, thinks that the physicalist owes us more. Hardin might be claiming that, if reflectance physicalism is true, the unique/binary distinction should be a "physically natural classification" of reflectance types. (Indeed, we have interpreted him that way in previous papers.[20]) However, this interpretation does not seem to be correct, because Hardin explicitly notes that Tye's theory fails to provide such a classification, and yet Hardin does not take this to be problematic.

It is not clear, then, what Hardin's objection is. Further, Hardin does not discuss the most developed physicalist-friendly accounts of the binary/unique distinction.[21] Pending further elaboration on Hardin's part, we can at least demand a Scotch verdict.

## III. VARIATION

Although there is much agreement on what is green, dark-green, and yellowish-green, there isn't much agreement on what possesses the highly determinate shades, like unique

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[19] Hardin, ibid., p. 198. For Hardin's original version of the objection, see *Color for Philosophers*.

[20] Byrne and Hilbert, "Color Realism and Color Science," "Colors and Reflectances"; A. Byrne, "Color and Similarity," *Philosophy and Phenomenological Research* 66 (2003): 641-65.

[21] Byrne, ibid.; Byrne and Hilbert, "Color Realism and Color Science"; Bradley and Tye, op. cit.

green. According to reflectance physicalism (and many other theories of color), some objects are unique green, and yet, with a fixed choice of viewing conditions, such objects will appear unique green only to a minority of normal perceivers. If, as Hardin says, "No scientific sense can be attached to the claim that some of the observers are perceiving the color of the stimulus correctly and others not"[22], then reflectance physicalism is false.[23]

(Hardin does not explicitly separate this objection from the one just discussed, but the two are quite different. The unique green objection, but not the unique/binary objection, crucially turns on color misperception.)

Suppose that a certain chip looks unique green to Fred in such-and-such viewing conditions. Let us grant, for the sake of the argument, that the facts of variation undermine Fred's perception-based reason to believe that the chip is unique green. (Note that this is consistent with Fred's knowing that the chip is *green*—and Hardin does not claim otherwise.) Generalizing, no one knows, of any object *o*, that *o* is unique green. (Note that this is consistent with our knowing that some objects *are* unique green—and Hardin does not claim otherwise.) Let us further concede, again for the sake of the argument, that this deficiency in our knowledge is an irremediable part of the human condition. In particular, the theory of perceptual representation will never advance to the

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[22] Hardin, "A Spectral Reflectance Doth Not a Color Make," p. 200.

[23] Ned Block ("Sexism, Racism, Ageism and the Nature of Consciousness," in *Philosophical Topics* 26 (1&2), *The Philosophy of Sydney Shoemaker*, ed. R. Moran, A. Sidelle, and J. E. Whiting (Fayetteville: University of Arkansas Press, 1999)) has a particularly sophisticated reply to this argument that we will not consider here. According to Block, individual differences in color perception of the sort Hardin mentions are not differences in the colors things look to have, but are rather non-representational differences in phenomenal character. A reflectance physicalist who agrees with Block may therefore claim that *all* "of the observers are perceiving the color of the stimulus correctly."

point where we will have some "independent method"[24] for determining exactly which properties our color experiences represent objects has having.

Now unless we make some controversial verificationist assumption, it is hard to see why this scenario makes "no scientific sense", or is otherwise objectionable. Imagine, as an analogy, a population of intelligent, reasonably accurate thermometers. To one of these thermometers, the ambient temperature just "seems" to be such-and-such degrees Fahrenheit, as a chip might seem to Fred to be unique green. Like all measuring instruments, the thermometers are calibrated slightly differently. They all agree that the temperature right now is pretty high, around 70°F or so. But some think the temperature is 69°F, while others think it's 70°F, and yet others think it's 71°F. Some of them conjecture that being 70°F is a physical property of some kind, perhaps related to mean molecular kinetic energy. But the thermometers have no theory of intentionality that would enable them to establish conclusively that they are representing physical properties of this sort. And, since they don't have other ways of measuring temperature, they have no "independent method" of determining whether the temperature right now is exactly 70°F, or even whether it's pretty high. Still, some of these thermometers are perceiving the temperature correctly and others are not. Further, this lack of an independent method need not stop them from forming justified beliefs about the temperature. Perhaps none of them can justifiably believe that the temperature is exactly 70°F, but presumably they might justifiably believe that it is on the high side, or approximately 70°F.

[24] Hardin, op. cit., p. 199.

As for the intelligent thermometers, so for us. Despite presently—and, perhaps, eternally—lacking an independent method to determine the veridicality of our color experiences, we may be reasonably accurate detectors of the colors of things.

ALEX BYRNE

Massachusetts Institute of Technology

DAVID R. HILBERT

University of Illinois at Chicago