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Objectivist Reductionism

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1 Objectivist Reductionism

Physical objects like lemons, canaries, and lumps of sulfur have a myriad of physical-chemical properties. Some of these properties are shared: all three kinds of objects have mass, for example. Some are unique: only lumps of sulfur are composed of a single element, give or take a few impurities. Some are partly shared: lemons and canaries both contain carotinoid pigments. We may assume that "physical-chemical properties" are specified in a relatively restricted language—in particular, one that does not contain color words like "yellow". Now imagine an uncountably large book in which all and only the shared physical-chemical properties of lemons, canaries, and lumps of sulfur are inscribed in this restricted language. Since objects of these three kinds are yellow, a question arises: Is yellowness among the properties mentioned in the book? Because the word "yellow" does not appear in the book, the answer isn't obviously yes. But neither is it obviously no: there's no problem in principle with expressions lacking color words referring to colors. So which is it? According to *Objective Reductionism*, or *(color) physicalism*, it is yes: yellowness is identical to physical-chemical property Y, and so on for the other colors.[1]

Objective Reductionism stands opposed to *Subjective Reductionism*, or *(color) dispositionalism*, the view that yellowness is identical to a disposition or tendency to affect perceivers in a certain way.[2] In an older and more traditional terminology, Objectivism Reductionism identifies yellowness with a *primary quality*, and Subjective Reductionism identifies it with a *secondary quality*. Objective Reductionism also stands opposed to *Primitivism*, on which yellowness is an irreducible property, and *Eliminativism*, the view that no physical objects are yellow.[3]

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[1] Objective Reductionists include Armstrong (1969), Smart (1975), Hilbert (1987), Jackson (1996), Tye (2000), McLaughlin (2003), Byrne & Hilbert (2003).

[2] As defined in the text, Objectivism and Subjectivism are actually compatible. A Subjective Reductionist might also hold that all properties are physical, in which case she would be an Objective Reductionist too. For our purposes, this awkwardness doesn't matter: the Objective Reductionists mentioned in this chapter are invariably opposed to the Subjective kind, and so here the two positions can be treated as incompatible.

[3] Another pair of distinctions, relativist/non-relativist and relational/non-relational, basically cuts across the distinctions just mentioned. For a relativist view, see Brogaard 2010; for a relational

The terminology of "Objective/Subjective Reductionism" is not ideal, mainly because "Subjective" can suggest "less than fully real", or "not part of the Absolute Conception of reality", or something along equally obscure lines.[4] Subjective Reductionism is simply committed to *subjects* (i.e. perceivers) figuring in the most perspicuous account of what the colors are, not anything more metaphysically heady. Conversely, the Objective Reductionist is simply committed to the identity with physical-chemical property Y, not the additional claim that Y figures in the Absolute Conception or anything of that sort.

2 Motivations

One might motivate Objectivist Reductionism as an instance of a more global claim, something like the contemporary doctrine of physicalism, that the world is (in some sense) "entirely physical". But Objectivist Reductionism can be motivated in a much more local (and much more convincing) fashion.

First, we can start by noting that colors are *properties* or *qualities* that have their own special vocabulary in natural languages ("green", "vert", "grün",…).[5] They are not *relations*, and there is no obvious reason why they are relational properties (like, say, poisonousness). These properties are among the ways external objects like cucumbers and avocados appear or look and plainly are very closely tied to vision. Since, as every child knows, cucumbers and avocados *are* green, vision enables us to detect the colors of things.

Second, changing the illumination, even quite dramatically, often does not change apparent colors significantly. A tomato appears to be stably red when we remove it from under the halogen kitchen light, take it outside into direct early morning daylight, and then put it in shadow. (This is the well-known phenomenon of *color constancy*.[6]) That suggests that colors are illumination-independent properties: changing the ambient light does not (typically) change the colors of things.

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view see Cohen 2009. (Cohen's alternative taxonomy of positions is also helpful: see 2009: ch. 1.) For criticism of both relativism and relationalism, see Byrne and Hilbert forthcoming. We will not discuss either of these positions in this chapter.

[4] For the Absolute Conception, see Williams 1978: 64-8 (and for Williams' views on its connection to color, 237-44).

[5] [[xREF science of color chapter]]

[6] [[xREF science of color chapter]]

Third, we aren't the only animals with color vision. Even without getting into any details about eyes, wavelength selectivity and so forth, a glance around the natural world strongly suggests that a lot of animal coloration is the result of natural selection, and moreover can only be selected because other animals can detect colors. Males' exotically colored plumage would be pointless if it were lost on females; similarly, camouflage often involves precise color matching, a puzzle if the predators are oblivious to color differences. As Darwin put it: "When we see leaf-eating insects green, and bark feeders mottled grey, the alpine ptarmigan white in winter, the red-grouse the colour of heather, and the black-grouse that of peaty earth, we must believe that these tints are of service to these birds and insects in preserving them from danger" (Darwin 1859: 84).

This third point, that we color-seeing humans are not alone, has a number of consequences. It shows that colors are ecologically significant (in different ways to different animals), which reinforces the second point. Properties of objects that do not change with constantly changing illumination are generally much more useful to know about. It also shows that the detection of colors simply requires an appropriate visual system, not any kind of conceptual sophistication. Finally, if we add in some facts about the design of other visual systems, the third point suggests that the familiar human colors are just a parochial subset of all the colors.

Summing up, the colors, on initial inspection:

(a) are (largely) illumination-independent properties of objects;

(b) are ecologically significant;

(c) are detectable by perceptual systems alone, without assistance from higher cognition;

(d) form a large family of properties, only some of which are detectable by human vision.

Human color vision works by sampling the image at the back of the eye with three kinds of broad-band receptors spanning the visible spectrum, followed by specialized processing to extract information about, among other things, the light-altering properties of objects. In general, color vision systems across the animal kingdom appear to be well-suited to detect ways in which objects alter light.

Thus the natural hypothesis is that colors *are* ways of altering the light. If we restrict attention to colors as they appear to qualify surfaces, then the hypothesis is that colors are *surface spectral reflectances* (SSRs)—dispositions to reflect incident light.[7] (In the case of humans, the pertinent kind of light is in the visible spectrum, but it need not be so restricted for other animals). Since this is the most plausible kind of Objective Reductionism, we will take this hypothesis, *reflectance physicalism*, as our central example.

Objective Reductionism is not the product of an ideology to "naturalize" everything that moves, or a doctrine whose main motivation is distinctively "philosophical". Rather, it falls naturally out of some elementary observations about language, biology, physiology, and phenomenology. For Martian scientists and philosophers, lacking any kind of color vision, Objective Reductionism (specifically, reflectance physicalism) would seem pretty boring. What could possibly be wrong with it?

3 Objections

As it turns out, quite a lot. To judge by the philosophical literature on color, Objective Reductionism is widely supposed to suffer from a number of fatal problems. We now discuss the most prominent of these, ranging from those that are easily dismissed to those that deserve serious discussion.

3.1 Metamers

Objects that alter light in quite different ways can nonetheless look to have exactly the same color in, say, daylight (more exactly, daylight of a specific kind). This is the phenomenon of *metamerism*: objects that differ in the amount of light they reflect at each wavelength—that is, in their reflectance—can nonetheless perceptually match under certain illuminants (including natural illuminants like daylight). Metamerism is a consequence of the fact that the cones in the eye are sensitive to wavelengths over a wide range, and so will repond identically to light of different wavelengths, if appropriately adjusted for intensity. Suppose *x* and *y* are a metameric match (in daylight); specifically, *x* and *y* both look exactly the same shade of magenta. We may further suppose that *x* and *y* *are* that shade. Yet (we may further suppose) the reflectance curves of *x* and *y* are quite different. (Say, *x* reflects 70% of light around 500nm, while *y* reflects none.)

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[7] To cover the case of colored lights and volumes, Byrne and Hilbert (2003: 11-12) identify the colors with *productances*, defined similarly but more generally than reflectances. This refinement can be ignored for present purposes.

If the slogan "colors are reflectances" is understood as identifying the shades that are (visibly) maximally determinate with specific reflectances, then this example shows that the slogan is wrong. *x* and *y* have the same (visibly) maximally determinate shade but different specific reflectances. So such shades are not specific reflectances.

However, this is a non-issue. Plainly determinables like red and blue, and less than maximally determinate shades like magenta and crimson, cannot be identified with specific reflectances. They must instead be identified with *types* or *kinds* of specific reflectances, or (in perhaps better terminology), *general* reflectances. A general reflectance stands to a specific reflectance as *being a rectangle of area* > *A* stands to *being a rectangle of area exactly A+n*. Once it is clear that red and magenta cannot be specific reflectances, there is no need for the Objective Reductionist to make an exception for red_{29}, a (visibly) maximally determinate shade, and every reason for her not to.

Although metamerism is not best thought of as providing an *objection*, it does bring out a distinctive feature of Objective Reductionism, namely that it recognizes invisible colors, in particular specific reflectances. According to the Objective Reductionist, what we intuitively think of as maximally determinate shades are in fact determinables in their turn, with absolute determinates only being reached at the level of specific reflectances. And we do not see specific reflectances—no object looks to us to have an absolute determinate color (rather, objects look to have one of the determinables of which specific reflectances are determinates). That result will be unacceptable to those who, like P. F. Strawson, think that "colours are visibilia, or they are nothing" (Strawson 2011: 142), but a clear case for treating colors differently from shape or motion is hard to find. Strawson, for instance, claims that a "logical divorce" between a thing's being a color and its looking that color "produces nonsense", but omits to explain why.

3.2 Normal conditions and standard observers

The Objective Reductionist identifies colors with general reflectances. But *what* general reflectance is to be identified with, say, yellowness? There are enormously (perhaps infinitely) many to choose from. Take some general reflectance G. Since the motivation for Objective Reductionism relies crucially on the idea that the colors of objects are (frequently) *detectable*, if G is a serious candidate for yellowness, it had better be a feature of many objects that we ordinarily see as yellow, like lemons. For if not, then many of our perceptual beliefs about yellowness, for instance that this lemon is yellow, would be in error. G, then, is a property of objects like lemons, canaries, and lumps of sulfur. But what unites these objects? The answer might be thought to lie in us, because:

> there seems to be no perceiver-independent way of specifying the disjunction of surface reflectance properties to which a particular colour shade is to be reduced. The different surface reflectance properties involved bear no intrinsic resemblance to each other; they form a disjunction simply because of the colour experiences they cause in perceivers. (Gow 2014: 806)[8]

Lemons, canaries and lumps of sulfur all *look* yellow to normal perceivers, so presumably the Objective Reductionist will identify yellowness with the general reflectance shared by all and only those objects that look yellow to normal perceivers (or, more carefully, normal perceivers in normal conditions). But now there is…

> …the problem of identifying, in a non-arbitrary way, *normal conditions*, and *normal observers*. The objectivist account requires that we identify the 'real' color for object *X* as a certain causal basis (e.g., the reflectance profile) for the way it appears, to normal observers and in normal conditions. The problem is that, as Hardin has persuasively pointed out…this cannot be done except in a highly arbitrary way. Not only is there a minority of color perceivers who are anomalous (only slightly, but appreciably so) with respect to normal observers, but there is a considerable statistical spread even within the group of normal observers. For example, the reflectance profile for unique green[9] will differ for different members of the 'normal group'. One can decide, of course, on a standard and fix one reflectance profile as green, but the procedure is highly arbitrary. (Maund 2012: sect. 6.3)[10]

This is a common complaint against the Objectivist. And there is indeed a serious problem, if the Objectivist is unwise enough to specify the colors in terms of "normal" perceivers and

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[8] This quotation might uncharitably be read as suggesting that the SSRs that correspond to the familiar colors look like a completely random selection, with no commonalities in how they alter light. In any event, that suggestion is quite wrong.
[9] Unique green is that shade of green that is neither yellowish nor bluish.
[10] For uniformity, we have silently replaced two occurrences of "standard" in this quotation with "normal".

conditions.[11] However, there is no reason to accept this poisoned pawn. True, perceptible properties are only detectable because of the effects they have on us, but to move from that to the conclusion that they are *definable* in terms of these effects is arguably the classic operationalist mistake.

Consider, for example, the word "craggy" as applied to mountain peaks and such. This word plausibly picks out a certain idiosyncratic shape property, of interest mainly to human climbers and hikers, possessed by Scafell Pike in the Lake District and not by Sugarloaf Peak in New Mexico. In other words, "Objectivist Reductionism" about cragginess is plausible: cragginess is identical to shape property S, a property canonically characterized in geometrical terms. S is some kind of "general" shape property, a type or kind of specific shape property. But what is S, canonically characterized?[12] Since our judgments of cragginess are (we may assume) often correct, we can use this to narrow down the candidates significantly, but since (we may also assume) error cannot be eliminated entirely, there will be numerous ones remaining. One of these must be S, but which is it? No one knows. It does not help to retreat from Objective Reductionism and try to analyze cragginess in terms of its effects on us—for one thing, the selection of the pertinent kinds of perceivers and conditions seems considerably more "arbitrary" than in the color case. And it is anyway quite unclear why the failure to supply S, in its geometrical guise, should embarrass the Objective Reductionist. Presumably "craggy" picks out S in virtue of complicated facts involving our use of the word, but we only have outlines of how this might work—certainly nothing that would enable us to expose S in geometrical terms. But our inability to produce a detailed theory of how we do such-and-such is no argument against us

[11] One problem is this: since there is no reasonable interpretation of "normal" on which *anything* is disposed to look unique green to normal perceivers in normal conditions, the proposed specification has the unwanted consequence that nothing is unique green (see Byrne and Hilbert forthcoming: section 2.2). Whether there is anything to the charge of "arbitrariness" is not obvious. If the winning lottery ticket number = 4985743, that is "arbitrary" in one standard sense, but of course that is not an objection to the identity! On another interpretation, the charge is that we have no way of knowing what the correct definition of "normal" is. But again, this does not appear to be an objection, at least not without further premises: the winning number may be 4985743 even though we have no way of knowing it.

[12] Competing theories of vagueness are not to the point. If, say, "craggy" somehow indeterminately picks out a range of shape properties, rather than a single one, then the corresponding question concerns this range, and the same issues will arise.

actually doing such-and-such. We may reasonably conjecture that cragginess is a certain shape property, even though we can only gesture towards it.

Objectivist Reductionism about color should be understood in an analogous fashion: if there is no pressure to reveal S, there is no pressure to reveal the general reflectance that is identical to yellowness.[13]

3.3 Variation among normal perceivers

As Hardin famously pointed out (see the previous quotation from Maund), there is significant variation among those with normal color vision, for instance variation with respect to which objects appear unique green. A question then naturally arises:

> [Imagine that all of the] hue chips manufactured by the Munsell Company covering [the] 5 Blue-Green to 2.5 Green range were randomly spread out before you to be separately viewed on a dark gray background in North Daylight. One of them would be your considered choice for unique green. Your colleague might make a different choice. If so, which of the chips is unique green? (Hardin 1993, 80)

Reading between the lines, Hardin's answer is evidently "none". What is not clear is why this—or, indeed, any noteworthy claim about color—is motivated by the dispute between you and your colleague. It's quite astonishing that our color vision systems are able to recover the colors of things at all; it should come as no surprise that there is variation between two "normal" color vision systems when pushed to their limits of resolution. If you and your colleague get slightly different results from your respective desk thermometers nothing alarming or noteworthy follows about the temperature of the office. Perhaps your thermometer is correct, and the temperature is 70°, or perhaps hers is, and the temperature is 68°. It may be in practice impossible to tell, but at least you both know that it's in the comfortable range. Similarly (or so one might think) with your dispute about the colors of the chips. Perhaps your color vision system is correct, and this chip is unique green, or perhaps hers is, and it's slightly bluish-green. It may be in practice impossible to tell, but at least you both know that it's in the middle-green range.

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[13] For another example, take the old Smart/Place "identity theory", that "sensations are brain processes" (Smart 1959: 144). Interestingly, the leading objections to this theory did not include the complaint that neither Smart nor Place revealed the particular brain processes that are identical to such-and-such sensations.

Those who think that variation does rule out Objective Reductionism have responded by questioning any analogy with measuring instruments (e.g. Cohen 2009: 47-52), and by taking up the challenge of turning the facts about variation into an argument (e.g. Cohen et al. 2006; Cohen 2009: ch. 2).[14] There seems little sign of a consensus, but in any case the objection from variation has nothing in particular to do with the "reductive" nature of Objective Reductionism. If the objection works at all, it works against any view of color on which only one of Hardin's chips is unique green, which includes the most natural form of Primitivism.

3.4 Boghossian and Velleman

In "Physicalist theories of color" (1991), Boghossian and Velleman launch a sustained attack on "physicalism about color", the view that "the colors of material objects are microphysical properties of their surfaces" (67); that is, Objective Reductionism.[15] Summarizing a rich and intricate paper, their main argument is the following. Divide Objective Reductionist views into two kinds. First, those on which:

> visual experiences like yours represent colors only as a matter of contingent fact. Under the terms of these theories, an experience internally indistinguishable from your experience of seeing something as red might fail to represent its object as having that color. The reason is that red is represented by your experience, according to these theories, only by virtue of facts incidental to the internal features of the experience. (Boghossian and Velleman 1991: 87)

One simple version of Objective Reductionism of this first kind is that "your experience of seeing something as red" represents its object as having the property P that is the normal cause of such experiences. (We may suppose that, as things have turned out, P is a certain general reflectance G*, and likewise for the other colors.)

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[14] See also Byrne 2006, Tye 2006, Byrne and Hilbert 2007, Cohen et al. 2007, Gert 2008.
[15] For the purposes of this chapter, we are eliding Boghossian and Velleman's distinction between "identity-physicalism" and "realization-physicalism" (1991: 73), analogous to the similarly-named views familiar from debates about functionalism in the philosophy of mind.

Objective Reductionist views not of the first kind are of the second kind. On these views, "an experience internally indistinguishable from your experience of seeing something as red" cannot fail to represent its object as being red.[16]

Having made this distinction, Boghossian and Velleman argue against both kinds of Objective Reductionism in turn. Their argument against the first kind is that it fails to meet certain simple epistemological constraints, for instance that, "simply in your capacity as a subject of visual experience", you know that "red and orange are different properties, though of the same kind—different determinates of the same determinable" (85). This is because, on theories of the first kind:

> [a] bizarre possibility is that visual experience might represent only two color properties—one when things look either red, orange, or yellow, and another when they look either green, blue, or violet. The correlational or causal facts could certainly be arranged in such a way as to give these experiences one of only two contents... These theories [of the first kind] therefore imply that one cannot always tell without investigation whether red and orange are different colors, the same color, or no color at all. (91)

Let us agree that this consequence is unacceptable. What is wrong with theories of the second kind, which do not have this consequence? Most current Objective Reductionists are also *intentionalists* or *representationalists* (examples include Byrne and Hilbert 1997 and Tye 2000; see also [[xREF Pautz chapter]]), which basically means that they deny that "an experience internally indistinguishable from your experience of seeing something as red" might fail to represent its object as being red.

However, Boghossian and Velleman argue against only one particular theory, and their argument against it does not extend to theories of the second kind of the sort currently in vogue.[17] Provided representationalism is viable, Objective Reductionists can escape Boghossian and Velleman's argument.

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[16] Although being "internally indistinguishable" is an epistemic matter (which raises unnecessary complications due to the fact that this relation is not transitive), we take it that this was not Boghossian and Velleman's primary intent: "identical with respect to phenomenal character" would be better.

[17] In fact, the theory they argue against, "that objects are visually characterized as having properties that normally cause color sensations, and that colors are the higher-order properties

3.5 Chirimuuta

In *Outside Color* (2015), Chirimuuta makes a number of objections to Objective Reductionism—specifically in the guise of reflectance physicalism or, in her terminology, "reflectance realism". We shall consider one of the most prominent, that there is "no-theory independent reason to assert that SSR detection is the primary function [of color vision] and that the others are secondary" (99). Other functions she mentions include the perception of depth, texture, edges and object boundaries. For example, as she notes (91), color vision is particularly useful for determining object boundaries because they are much better correlated with reflectance boundaries than with luminance boundaries (which could be caused by a shadow cutting across an object).

We may take the "function" of some adaptive subsystem in an organism to be its *biological function*—roughly, the features of the system that were selected for (see, e.g., Millikan 1984: ch. 1). Thus the function of the heart is to pump blood, or to deliver oxygen to the body, or something along similar lines; at any rate, it is not to make a thumping noise. How do we get from this multiplicity of functions of color vision to the conclusion that Objective Reductionism is false? It would certainly be an embarrassment if SSR detection was not *one* of the functions of color vision, for then there would be no obvious reason why selective pressure would have produced a system that could accurately recover (general) reflectances. Admittedly, there would presumably have been selection for accurate recovery of *differences* in reflectances (as in the example of object boundaries above), but that could have been accomplished while getting the reflectances themselves wrong or, more simply, by not attempting to recover such information in the first place. However, Chirimuuta's claim is that SSR detection is not the "primary function" of color vision; the experimental work she cites does not suggest that it is not a function at all.

There thus remains a gap between Chirimuuta's premise and her conclusion. Pending some clarification of the notion of a "primary function", the Objective Reductionist need not insist that SSR detection is the *primary* function of color vision—*a* function of color vision will do. In fact, Chirimuuta's discussion in effect reinforces the position she intends to attack. If evolution could have equipped us with an SSR detection system, it would have. Not only is the detection of SSRs useful in itself, but such a system is handy for all sorts of other things. And if

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expressed by these characterizations" (104), is better classified as a version of Subjective Reductionism.

we have an SSR detection system, then what else could it be other than our color vision system? Reflectance physicalism then becomes hard to avoid.[18]

3.6 Similarity, and the unique/binary distinction

The quotation from section 3.4, in which Boghossian and Velleman mention some things you know about red and orange "simply in your capacity as a subject of visual experience", continues:

> you know…that they are not as different from one another as they are from blue…A property that wasn't…similar to red—such a property simply wouldn't be orange. (1991: 85)

In the same vein, Boghossian and Velleman could have mentioned the distinction between the unique and binary hues—a property that wasn't a binary hue wouldn't be orange either. These elementary facts about similarity and the unique/binary distinction give us an argument against Objective Reductionism, as Hardin pointed out:

> [Objective Reductionism] fails because nothing in the domain of objects, properties and processes beyond our skins is both causally connected with our colour experiences and models the essential characteristics of colours. (1984: 496)

Imagine a Martian physicist, well versed in optics but entirely lacking color vision, cataloguing the general reflectances that the Objective Reductionist identifies with the colors. The Martian might well classify them by similarity, putting the reflectances with a high peak towards the long wavelength end together, say. The Martian might also classify some reflectances as combinations or mixtures of others, in a variety of mathematically natural ways. But we can be quite sure that none of this is going to "model the essential characteristics" of colors. The unique/binary distinction, and the similarity relations between the hues, will remain entirely beyond the Martian's ken.

Focusing on the more straightforward case of similarity, we can set out the argument as follows. Let G^o be a reflectance that is, according to the Objective Reductionist, a candidate to be orange (likewise G^r (red) and G^b (blue)):

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[18] For more discussion of Chirimuuta, see Cohen 2015.

P1. Orange is more similar to red than it is to blue.

P2. G^o is not more similar to G^r than it is to G^b.

C. Either $G^o \neq$ orange, or $G^r \neq$ red, or $G^b \neq$ blue.[19]

The argument appears to be of the valid form: Rabc, ~Rdef, hence a ≠ d v b ≠ e v c ≠ f. Since we may assume that P2 is equally plausible for any candidates to be orange, red, and blue, if C is warranted so is the stronger conclusion that Objective Reductionism is false.

Arguments in this style are quite widely endorsed. Here is Pautz, for example:

> [T]he thesis that colours are literally identical with reflectance properties cannot be correct because it entails that certain obvious claims about colour structure are false: for instance, that red is a unitary colour while purple is a binary colour, and that blue resembles purple more than green. The reason is that reflectance properties do not have the requisite structural features. (2006: 536)

And Chirimuuta:

> Physicalism is vulnerable to a line of attack that, broadly speaking, points out the great dissimilarities between features of color as we experience them, such as the structure of color space, and what is known of physical properties, such as SSR. (2015: 46-7)

It is hard to deny the premises of the argument as just set out. If the argument really is valid then Objective Reductionism is sunk; nevertheless, it is invalid. Compare the following argument:

P1*. Peter Parker is more similar to Clark Kent than to Bruce Wayne.

P2*. Spiderman is not more similar to Superman than he is to Batman.

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[19] Here is the parallel argument using the binary/unique distinction:

P1. Orange is binary.
P2. G^o is not binary.
C. $G^o \neq$ orange.

The reason why this argument is less straightforward is that it is not immediately obvious how to determine whether G^o is "binary" in the intuitive sense in which orange is. In his exposition of this argument, Hardin writes: "If hues are physical complexes, those physical complexes must admit of a division into unique and binary complexes" (Hardin 1988: 63), but gives little guidance on what this division comes to. For discussion see Byrne and Hilbert 2003: 13-5.

C*. Either Clark Kent ≠ Superman, or Peter Parker ≠ Spiderman, or Bruce Wayne ≠ Batman.

The first premise is true. Peter Parker is a freelance photographer for the *Daily Bugle*; Clark Kent is a reporter for the *Daily Planet*; Bruce Wayne is a billionaire and playboy. The second premise is also true: Spiderman and Batman are both men with a fetish for animal-inspired costumes; Superman is a space alien.[20] Despite the truth of the premises, the conclusion is false, as all philosophers of language know.

The argument is invalid because different respects of similarity figure in (the natural interpretation of) the two premises. P1* says (roughly) that three people are comparatively similar *with respect to their ordinary lifestyles and occupations*; P2* says that the same trio are comparatively similar *with respect to their superhero identities*. The argument is not of the valid form: Rabc, ~Rdef, hence a ≠ d v b ≠ e, or c ≠ f. Rather, the comparative similarity predicate is four-place: *x* is more similar to *y* than it is to *z* in respect *i*. The argument is thus of the invalid form: Rabcg, ~Rdefh, hence a ≠ d v b ≠ e v c ≠ f. And if validity is restored by keeping the respects of similarity constant between P1* and P2*, there is now no reason to affirm both premises. Interpreted with shifting respects of similarity, the argument is invalid; interpreted with constant respects of similarity, it is unsound.

Similar remarks go for the similarity argument against Objective Reductionism, although here there is much more to be said. What is the respect in which orange is more similar to red than to blue? Putting it intuitively but not particularly helpfully, orange "has some red in it", and "has no blue in it". The task is to explain what that means, in such a way that we can assess whether there is any difficulty in supposing that G^o "has some red in it".

Byrne and Hilbert (2003: 14; see also 2010: 280-1) proposed that the visual perception of an object as orange involves representing the object as having a roughly equal proportion of the two "hue magnitudes" reddishness and yellowishness, which are themselves identified with light-altering magnitudes. (Since the account is inspired by the phenomenological observations that motivated the opponent process theory of color vision, there are two other hue magnitudes, blueishness and greenishness.) According to Byrne and Hilbert, a property P will "have some red in it" just in case having P partly consists in having some proportion of reddishness. Since there

[20] Needless to say, quibbling over details of superhero interpretation is not to the point.

is no obstacle to taking reddishness to be a physical magnitude, the supposition that G° "has some red in it" is, they say, unproblematic.

Byrne and Hilbert's positive account is controversial.[21] However, whatever its fate, that does not alter the fact that the argument from similarity against Objective Reductionism is invalid. Validity could be restored by keeping the respects of similarity constant between P1 and P2—a likely candidate would be "natural respects", in something like Lewis's sense of "natural" (Lewis 1983). But now the similarity objection to Objective Reductionism is far from straightforward, hinging on metaphysical speculations that are easy to dispute. First, it is not clear that the colors are similar in natural respects; second, the need for the Lewisian apparatus of natural properties is disputable. If Objective Reductionism is a natural hypothesis given established science,[22] then appeal to the darker regions of contemporary metaphysics is unlikely to overturn it.

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[21] The simple account of color phenomenology used by Byrne and Hilbert is at best an oversimplication (for some of the complexities see Allen 2015). However, it is unclear whether the complications significantly affect the basic idea. See also [[xREF Pautz, fn. 10]].

[22] Of course, this is not to say that color scientists themselves embrace Objective Reductionism.

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