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COLOR PRIMITIVISM

ABSTRACT. The typical kind of color realism is *reductive*: the color properties are identified with properties specified in other terms (as ways of altering light, for instance). If no reductive analysis is available – if the colors are primitive sui generis properties – this is often taken to be a convincing argument for eliminativism. That is, *realist primitivism* is usually thought to be untenable. The realist preference for reductive theories of color over the last few decades is particularly striking in light of the generally anti-reductionist mood of recent philosophy of mind. The parallels between the mind–body problem and the case of color are substantial enough that the difference in trajectory is surprising. While dualism and non-reductive physicalism are staples, realist primitivism is by and large a recent addition to the color literature. And it remains a minority position, although one that is perhaps gaining support. In this paper, we investigate whether it should be accepted, and conclude it should not be.

1. INTRODUCTION

Philosophical discussions of color have been pre-occupied with the question of what the colors are. Unsurprisingly, philosophers have managed to identify a number of possible answers to this question. The principal options advocated in the recent literature are: colors are ways of altering light (Tye, 2000; Byrne and Hilbert, 2003a); properties of a sense-datum-like mental array (Boghossian and Velleman, 1989); properties that are entirely uninstantiated (Averill, 1992; Hardin, 1993; Maund, 1995); dispositions to cause color experiences (McGinn, 1983; Smith, 1990; Johnston, 1992); the ground of such dispositions (Jackson, 1996; McLaughlin, 2003; Cohen, 2004); and "ecological" dispositions (Thompson, 1995; for a related view see Noë, 2006, ch. 4).[1]

Some of these views are *realist*: objects like oranges and lemons have the colors we mostly take them to have. Others are *eliminativist*: oranges and lemons are not colored. The usual kind of realism is *reductive*:

the color properties are identified with properties specified in other terms (as ways of altering light, for instance). If no reductive analysis is available – if the colors are primitive *sui generis* properties – this is often taken to be a convincing argument for eliminativism. Realist primitivism, in other words, is usually thought to be untenable.

The realist preference for reductive theories of color over the last few decades is particularly striking in light of the generally anti-reductionist mood of recent philosophy of mind. The parallels between the mind–body problem and the case of color are substantial enough that the difference in trajectory is surprising. While dualism and non-reductive physicalism are staples, realist primitivism is by and large a recent addition to the color literature. And it remains a minority position, although one that is perhaps gaining support. In this paper, we investigate whether it should be accepted, and conclude it should not be.

2. PRIMITIVISM EXPLAINED

2.1. *Varieties of Primitivism*

The minimal defining feature of primitivism is simply that the colors are not identical to physical properties (e.g. ways of altering light), dispositions to affect perceivers, and the like: colors are *sui generis* properties. Call this view 'Minimal Primitivism', or 'MP'. Primitivists usually go further, and for our purposes we can take the view to be somewhat stronger than Minimal Primitivism.

Primitivists typically hold that there is a single property of blueness, redness, and so on; they therefore reject the relativist view that the colors are properties indexed by perceivers and viewing conditions–blue-for-perceiver-S-in-conditions-C, for instance (McLaughlin, 2003; Cohen, 2004). So at least for simplicity, primitivism also includes the following thesis, which will be presupposed for the rest of this paper:[2]

ANTI-RELATIVISM (AR) Colors are not relational properties, where the relata are perceivers and/or viewing conditions.

With MP&AR as the common core, there are a number of different versions of primitivism. The first of the two major choice points concerns whether physical objects like rubies, emeralds, oranges and lemons are colored. According to *realist* primitivism (R-primitivism), they are. R-primitivism adds the following thesis:

ANTI-ELIMINATIVISM (AE) Physical objects like lemons are colored; moreover, they often have the colors we take them to have, and often lack the colors we take them to lack.

And since the colors presumably must do *some* causal work if we are to perceive them, we may take R-primitivism to include:

CAUSATION (C) That objects have colors is sometimes part of a causal explanation: in particular, that an object x has color *c* is often part of the causal explanation of why x looks to have *c*.

In contrast, according to *eliminativist* or *error-theoretic* primitivism (E-primitivism), objects in our environment are not colored, and so E-primitivism adds the following thesis to MP&AR:

ELIMINATIVISM (E) Physical objects like lemons are not colored.[3]

The second major choice point concerns the relation between the colors and the physical properties that a color physicalist would identify with the colors. Solely for illustration, let us take *reflectance physicalism* as our representative physicalist theory (Hilbert, 1987; Byrne and Hilbert, 1997c; Tye, 2000).[4] Ignoring irrelevant details, the *reflectance* of an object is the proportion of incident light it reflects at each wavelength in the visible spectrum. According to the reflectance physicalist, colors are *reflectance types*, or disjunctions of reflectances. These reflectance types are, in the terminology of Hilbert (1987), "anthropocentric"; in the terminology of Lewis (1983) they are not very "natural" properties. Although reflectance types are not of particular interest to a physicist, they are nonetheless physical properties – at least in an inclusive sense of 'physical'.

According to the R-primitivist, the relation between reflectance types and colors is not identity. But it can hardly be an entirely accidental correlation: if tomatoes had reflected light very differently, they would not have been red. There are two basic positions: either the correlation is nomological (albeit contingent), or else it is metaphysically necessary. We may take a proponent of the first position – NC R-primitivism – to hold:

NOMOLOGICAL COEXTENSIVENESS (NC) For any color *c*, there is a reflectance type P such that P is nomologically coextensive with *c*. Equivalently: it is a law that for every object x, x has P iff x has *c*.

A proponent of the second position – MD R-primitivism – holds:

METAPHYSICAL DETERMINATION (MD) For any color *c*, there is a reflectance type P such that P metaphysically necessitates *c*. Equivalently: it is metaphysically necessary that for every object x, if x has P, x has *c*.

An MD R-primitivist might also maintain this stronger thesis:

METAPHYSICAL COEXTENSIVENESS (MC) Colors are (metaphysically) necessarily coextensive with reflectances.

(For maximum generality, replace 'reflectance type' in the above three theses with 'physical property'. But for the sake of a concrete example we will stick with reflectance types.[5])

2.2. *Revelation*

A thesis that often turns up in discussion of primitivism is one Johnston has dubbed:

REVELATION The intrinsic nature of canary yellow is fully revealed by a standard visual experience as of a canary yellow thing (Johnston, 1992, p. 138), and likewise for the other colors.

As we shall explain, primitivism and Revelation are intimately connected. But before doing that, Revelation needs more explanation.

It is perhaps not entirely clear what the "intrinsic nature" (or, simply, "nature" or "essence") of a property is supposed to be, but we assume it is clear enough for present purposes. If colors are ways of altering light, for instance, then a description of the nature of canary yellow would certainly need to specify in canonical physical terms the exact way of altering light that is identical to canary yellow. And the fact (if it is one) that canary yellow is more similar to ochre than it is to teal is again something that a description of its nature needs to mention. On the other hand, any defensible description of the nature of canary yellow will omit the fact that some Post-it notes are canary yellow, the fact that canary yellow is Johnston's favorite example of a color, and even the necessary fact that canary yellow is Johnston's *actual* favorite example of a color.

Revelation admits of two readings. Suppose that it is in the nature of the colors that canary yellow is more similar to ochre than it is to teal, and that Revelation is true. Is what is revealed simply that canary yellow is more similar to ochre than it is to teal, or is it that this similarity is in the nature of the colors? These are of course different options. To borrow an example from Leibniz, suppose (no doubt contrary to fact) that it is in my nature that I make a certain journey. It may be revealed that I make the journey, without it being revealed that this is in my nature.

Johnston plainly intends the stronger reading – "canary yellow is counted as having just those intrinsic and essential features which are

evident in an experience of canary yellow'' (Johnston, 1992, p. 139) – and that is the one we will adopt here.

Another issue concerns the relevant sorts of color experiences that, according to Revelation, are supposed to deliver the nature of the colors. The quotations from Johnston might suggest that Revelation implies that single glance at a canary yellow object is sufficient to reveal the nature of canary yellow, but we assume this would be a misreading. It is consistent with Revelation that the full nature of canary yellow will only be apparent after a diverse range of color experiences – including, perhaps, experiences as of transparent canary yellow volumes, canary yellow lights, and canary yellow objects against a variety of backgrounds.[6]

Although statements of Revelation, including Johnston's, are often somewhat vague, for present purposes we can treat Revelation as equivalent to the conjunction of two theses, the first of which is:

SELF-INTIMATION If it is in the nature of the colors that *p*, then after careful reflection on color experience it seems to be in the nature of the colors that *p*.

The second is the converse:

INFALLIBILITY If after careful reflection on color experience it seems to be in the nature of the colors that *p*, then it is in the nature of the colors that *p*.[7]

Self-Intimation, in particular, is a very strong thesis. It implies that colors are *not* reflectance types, for example. If they are reflectance-types, then it is in the nature of the colors that they are reflectance types. And if it is in the nature of the colors that they are reflectance types then, by Self-Intimation, this fact is apparent from careful reflection on color experience, which it isn't. By the same token, if Self-Intimation is true, colors are not dispositions to affect perceivers, microphysical properties, chemical properties, ectoplasmic properties, and so on. The only nature or essence of the colors apparent from reflection on color experience is chromatic through and through. Hence Self-Intimation – and so Revelation – entails Minimal Primitivism.[8,9,10]

What about the other direction? Does Minimal Primitivism entail Revelation?

Evidently Minimal Primitivism does not entail Infallibility. The claim that colors are not reflectances (etc.) is *consistent* with its being in the nature of the colors that canary yellow is *not* more similar to ochre than to teal – moreover, that canary yellow is more similar to teal than to ochre. But, since (we may grant) it *seems* true that it is in the nature of the colors that canary yellow is more similar to ochre than to teal, under such a supposition Infallibility is false. Neither

does Minimal Primitivism entail Self-Intimation. Suppose that contrary to appearances it is in the nature of the colors that canary yellow is more similar to teal than to ochre; as just mentioned, this is consistent with Minimal Primitivism. But then there is a truth about the nature of the colors that does not seem true after reflection on color experience, and so Self-Intimation is false.

However, with a relatively innocuous assumption, and making allowances for the vagueness and unclarity of these doctrines, Minimal Primitivism conjoined with Infallibility entails Self-Intimation.

According to Minimal Primitivism, the colors are *sui generis* properties, which we earlier expressed by saying that the colors are not identical with properties specified in other terms. But this is not quite right, because (to adapt an example just given), even a primitivist can agree that canary yellow *is* Johnston's favorite property, and hence that it is identical to a property specified in other terms. And if 'Johnston's favorite property' is disallowed because it is nonrigid, 'Johnston's actual favorite property' may be substituted instead.

Minimal Primitivism may be further explicated by the claim that the colors have no non-chromatic nature, in the following sense: if 'It is in the nature of the colors that *p*' is true, then '*p*' is a *purely chromatic* sentence – a sentence that is (at least) solely composed of topic neutral and color vocabulary. Examples of purely chromatic sentences include: 'Every shade of orange is reddish', 'Canary yellow is not a shade of blue' (Johnston's example), 'Canary yellow is a shade of blue', 'Purple is more similar to red than to yellow', 'Brown is blackened orange', and so on.[11]

Let *Q* be the (true) proposition that it is in the nature of the colors that *p*. (Since *Q* is true, it is also true that *p*.) If all such propositions seem true after careful reflection on color experience, then Self-Intimation follows. Assume that Minimal Primitivism is true, and hence that '*p*' is purely chromatic.

Suppose that *Q* does *not* seem true after reflection on color experience. There are two cases: (i) either *Q* does not seem true because ~*Q* seems true, or (ii) neither *Q* nor ~*Q* seem true – color experience is silent on whether *Q* is true.

Case (i) is ruled out by the assumption of Infallibility. Supposedly, 'It seems *not* to be in the nature of the colors that *p*' is true. What sentences α are such that ⌜It seems not be in the nature of the colors that α⌝ is true? Almost any sentence: it seems not to be in the nature of the colors that tomatoes are red, that tomatoes are fruits, that it's raining, that it's not raining,.... But, given Minimal Primitivism, '*p*' is

purely chromatic, which narrows the field considerably: it seems *not* to be in the nature of the colors that every shade of orange is greenish, that canary yellow is a shade of blue, and so forth. Since (we may grant) it seems to be in the nature of the colors that *no* shade of orange is greenish, that canary yellow is *not* a shade of blue (etc.), by Infallibility it *is* in the nature of the colors that no shade of orange is greenish (etc.). Plausibly, given Infallibility, if 'It seems *not* to be in the nature of the colors that *p*' is true, and '*p*' is purely chromatic, then '*p*' is *false*.[12] But, since by hypothesis '*p*' is true, case (i) is ruled out.

That leaves case (ii). Could careful reflection on color experience fail to deliver a verdict on whether it is in the nature of the colors that *p* (where '*p*' is purely chromatic)? For example, might reflection leave one undecided whether it is in the nature of the colors that blue is the hue that is brightest at maximum saturation, or whether red_{17} (a very fine grained shade) is more similar to $purple_{93}$ than to $purple_{94}$? At any rate if we idealize the "careful reflection", the relevant range of color experience, and the subject's powers of discrimination, there is some initial plausibility to the view that a verdict (right or wrong) *would* be forthcoming – call this *Completeness*. With that assumption, case (ii) is also ruled out. We may conclude that – vagueness and unclarity aside – Minimal Primitivism, Infallibility, and Completeness entail Self-Intimation.

Now Infallibility is widely regarded as true. Theorists of color typically affirm, not just that it *seems* to be in the nature of the colors that red is more similar to orange than to green, and so forth, but that this *is* in the nature of the colors. Thus Hardin:

> One can succeed in the task of identifying the hues with some physical structure only if that structure captures the *essential* features of the hues as these are displayed to us in experience...hues do have certain characteristics necessarily...If we reflect on what it is to be red, we readily see that it is *possible* for there to be a red that is unique, i.e., neither yellowish nor bluish. It is equally apparent that it is *impossible* for there to be a unique orange, one that is neither reddish nor yellowish. (Hardin, 1993, p. 66)

Theories that seem unable to accommodate such ostensible facts about the nature of the colors are thereby taken to be refuted. (See also Boghossian and Velleman, 1991; Johnston, 1992.) And in any case Infallibility is a natural thesis for a primitivist to hold – we may take it as a background assumption for all primitivists. Given this background assumption and the relatively harmless assumption of Completeness, Revelation is not an optional extra for primitivists: it is tantamount to Minimal Primitivism.

3. PRIMITIVISM: A POTTED HISTORY

E-primitivism can be found in Descartes. First, there is the Cartesian idea that careful introspection reveals the essence of the mental – in other words, Revelation-about-the-mind is true. Second, there is the Cartesian idea that color is in the mind, not in bodies (see, in particular, Descartes, 1644/1985, part I, p. 68). Putting those two together yields Revelation and Eliminativism, and hence E-primitivism.

Often, although not always, contemporary color eliminativists at least flirt with Revelation, and can be classified as E-primitivist sympathizers; notable examples include Hardin (1993), Maund (1995), Boghossian and Velleman (1989, 1991), Averill (1992), and Chalmers (2006).

R-primitivism can be found in Berkeley. First, that the essence of the mind is transparent to itself is a doctrine congenial to Berkeley. Second, Berkeley thinks colors "have no existence without the mind" (Berkeley, 1734/1994, p. 22). Third – the Berkelean master stroke – Berkeley nonetheless maintains that "colors and other sensible qualities are on the objects...*snow is white*" (Berkeley, 1734/1994, p. 62, our italics). Putting the first and second together yields Revelation; the third yields Anti-Eliminativism; hence all three yield R-primitivism.

Of course, Berkeley-style R-primitivism is purchased at the rather steep price of idealism. Clear examples of versions of R-primitivism where the colors are not treated as mental properties of any sort do not emerge (as far as we can imperfectly discern) until the last century. If we date contemporary theorizing about color from Smart's classic 1968 paper, "On some criticisms of a physicalist theory of colors", then the earliest contemporary R-primitivist is probably Cornman (1971, 1975).[13]

The attribution of R-primitivism to Cornman is not entirely straightforward. His main concern is whether scientific realism and common sense realism are compatible, and he argues that they are. For his purposes it suffices to show that there are some open possibilities for integrating the colors with science, and consequently he need not, and in fact does not, endorse any particular proposal as to the nature of the colors. But his discussion strongly suggests that he thinks it obvious that colors are not to be identified with any properties already in the scientific inventory, which amounts to saying that the colors are *sui generis*.[14]

Notable recent writers who may be tentatively outed as R-primitivists include Hacker (1987) and Stroud (2000). Clear examples include Campbell (1993), Watkins (2005), and Westphal (1991, 2005). As between physicalism and R-primitivism, Broackes (1992) is an undecided voter. Yablo (1995) has at least some sympathy with R-primitivism; we will return to his view and also to Campbell's in Section 5.[15]

4. R-PRIMITIVISM OR E-PRIMITIVISM?

As mentioned in the introduction, two kinds of theory of color are *eliminativist*, and *reductive realist*. In the abbreviations of Section 2.1:

eliminativist theories imply E
reductive realist theories imply AE&~MP

It is often tacitly assumed (or, sometimes, explicitly argued) that all viable theories of color are either eliminativist or reductive realist. If this is right, then R-primitivism (which implies AE&MP) is not a viable theory of color. Unfortunately, if R-primitivism is off the table, the remaining choice between eliminativist and reductive realist theories can begin to look like a dilemma.

Take eliminativist theories first. Although undeniably popular, they present both a puzzle and a slippery slope. The puzzle is how, if nothing in the environment is colored, the visual systems of humans (and, presumably, other animals) have evolved to represent a range of properties that nothing has. The slippery slope is greased by the fact that in the philosophy of perception, for the most part color just plays the role of an especially colorful example. The considerations that favor a particular view about color would be expected, mutatis mutandis, to apply to other perceptible properties such as sounds and tastes. Hence, if eliminativism about color is correct, then a more widespread eliminativism is in the offing. Perhaps this does not extend across the board (the obvious suggestion is to try to hold the line at some contemporary reconstruction of Locke's primary qualities), but it is somewhat unclear what could stop the eliminativist virus from spreading.[16] And if eliminativism is of wide application, then the relation of the organism to its environment is decidedly strange. As Johnston puts it:

...the picture of our species which emerges from a generalized projectivism is of an animal whose basic mental habits, capacities, tendencies are not so many mental adaptations to reality but rather a repertoire of elaborate errors. The environment of this animal is so deracinated and the animal's tendencies are so complex that we

cannot appeal to a model of adaptation of minded organism to the antecedent demands of features of the environment to be grasped and dealt with. We can no longer see mentation as a type of fittedness to what is there, but only as an accidental elaboration of an inner life of great complexity, an elaboration not fundamentally constrained by a responsiveness to how things are. (Johnston, 1998, p. 4)

Now turn to reductive realist theories, which come in two basic types. First, *physicalist* theories – reflectance physicalism, for instance. Second, (reductive) *dispositionalist* theories, which identify colors with dispositions to produce psychological effects. Importantly, these psychological effects must not be characterized in terms of colors, else the dispositional theory will not be reductive. So a statement like 'Blueness = the disposition to look blue' does not – at least without some reductive gloss on the right-hand side – express a version of reductive dispositionalism.

A major problem with reductive theories is that they seem not do justice to the "qualitative nature" of color. For example, physicalists are often charged with a failure to account for the distinction between unique hues like green, and binary hues like orange (Hardin, 1993, pp. 65–66). A major problem with dispositionalist theories is that they in effect account for the qualitative nature of color by implausibly locating it in the "dustbin of the mind".

The theorist seems caught between a scarcely coherent picture of the organism and its environment, and gainsaying the nature of color. R-primitivism would appear to avoid the dilemma nicely. As desired, the organism's environment is populated by colors; and since the colors are not reduced to anything, they can be simply left to be themselves – no strained account of their qualitative nature is needed.

The question of the viability of R-primitivism is therefore of the first importance. But, as we have noted, many think that R-primitivism is just too good to be true. According to them, the only viable form of primitivism (at best) is E-primitivism. That is:

$(P \rightarrow EP)$
If primitivism is true, E-primitivism is true.

The next three sections examine the main arguments for $(P \rightarrow EP)$ that do not purport to establish the stronger thesis that primitivism in general is false.

4.1. *Causation*

Probably the most popular case for $(P \rightarrow EP)$ turns on considerations of causation. Any color realist holds Causation (see Section

2.1): that an object x has color *c* is often part of the causal explanation of why x looks to have *c*. But – the argument runs – only the physical properties of an object (and, perhaps, its dispositions to affect perceivers) are needed to explain why it looks to have a particular color. Hardin directs a version of this argument against R-primitivism as defended in Cornman (1975):

> But is there any reason to suppose that colors *are* among the elementary properties of bodies [i.e. that R-primitivism is true]? Consider: either the colors that Cornman supposes to attach to physical objects (call them *Cornman colors* or *C-colors* for short) are causally connected to the other physical properties of those objects or else they are not so connected. Suppose that they are, and that C-colors have physical effects. Then one ought to be able to test for their presence or absence by physical means, and a physical theory that makes no reference to them would be incomplete. But Cornman makes no claim to be remedying a deficiency in existing physical theories. So it seems that we must take C-colors either to be free of causal relations to an object's physical properties or else to be epiphenomena of some of them. In neither case will C-colors play a role in determining what wavelengths of light are emitted or reflected from or transmitted through the surface of a physical object. How, then, could they make any difference to our beliefs about colors? (Hardin, 1993, p. 61)[17]

In fact, there are two quite different causal objections to R-primitivism. The first is essentially Kim's problem of "causal/explanatory exclusion " (Kim, 1993, 1998), familiar from the mental causation debate. Consider a yellow lemon. Any R-primitivist will agree that an object with color *c* possesses a physical property that is (metaphysically or nomologically) *sufficient* but *not necessary* for having *c*. Using our illustrative example of reflectance physicalism, the reflectance of a particular yellow lemon (call it 'R^{y}_{1}') is, we may suppose, sufficient for being yellow. But it is not necessary for being yellow: other yellow objects have different reflectances R^{y}_{2}, R^{y}_{3},... – indeed, even other yellow objects that perceptually match the lemon in daylight. These reflectances R^{y}_{1}, R^{y}_{2}, R^{y}_{3},... then, may be said to *realize* yellowness, just as "c-fiber firing" is often supposed to realize pain. Returning to our lemon, the problem is this. The lemon's having R^{y}_{1} causally explains its looking yellow, and barring a weird kind of overdetermination, this explanation would appear to screen off or exclude the lemon's *yellowness* from doing any causal work. And if Causation is false, and the lemon's primitive yellowness is causally idle, then our visual systems are presumably not *detecting* the lemon's yellowness – in other words, we cannot see that the lemon is yellow.

Two points can be made in reply. First, the argument threatens much more than R-primitivism; second, the argument is anyway quite suspect.

Taking the first point first, the exclusion problem extends far beyond the realm of mental and chromatic causation. Indeed, as many have emphasized, the scope of the problem is vast, threatening causal explanations across the "special sciences" – biology, geology, economics, and so on.[18] Moreover, the exclusion problem also arises for other theories of *color* (see, e.g., Smart, 1975; Johnston, 1992). Reflectance physicalism itself is an especially clear case. According to the reflectance physicalist, yellowness is a reflectance type or disjunction of reflectances: R^{y}_1 v R^{y}_2 v R^{y}_3,... Because having R^{y}_1 is sufficient but not necessary for having the disjunction, R^{y}_1 apparently screens off the lemon's yellowness. The exclusion problem can therefore hardly be wielded as a scalpel to excise R-primitivism, leaving the rest of our body of theory intact.[19]

As to the second point, arguably the realized property is *better* suited to causal explanation than its individual realizers, and so there is no reason to think that the realized property does no causal work. For instance, the overheating of one's car tires would appear to be better explained by the fact that the tire pressure was less than 20 psi, than by the fact that it was exactly 15: the tires would have overheated if the pressure had taken any value less than 20 (see Yablo, 1992, 1995; Watkins, 2005).[20] Likewise, an explanation of why the lemon looks yellow in terms of its yellowness is better than an explanation in terms of its determinate reflectance. The former explanation is more general: the lemon would have looked yellow even if it has some other reflectance, provided it was still yellow. As Campbell puts it, "[T]he explanation in terms of redness adds modal data to a description of the physical sequence. It says that in nearby worlds in which the physical character of the thing was varied but its redness maintained, an experience of redness was still the upshot" (Campbell, 1993, p. 263; see also Byrne and Hilbert, 2003c).[21]

The objection from causal/explanatory exclusion, then, is unpersuasive. The view the colors are reflectance types remains intact; for similar reasons, so does the view that colors are primitive properties that are correlated with those types.

This brings us to the *second* causal argument for (P $\rightarrow$ EP), which seems closest to the one that Hardin has in mind. The second argument, unlike the first, is just directed against the NC (Nomological Coextensiveness) variety of R-primitivism: the primitive colors are tethered to physical properties such as reflectances by contingent chromophysical laws. And, also unlike the first, the second argument does not appeal to the causal efficacy of the realizers of colors.

Suppose, then, that the colors are nomologically coextensive with physical properties; for illustration, that there is a contingent chromophysical law that anything with the reflectance type R^y ($= R^y_1$ v R^y_2 v R^y_3,...) is yellow, and vice versa. Since this chromophysical law is contingent, it might not have obtained. Further, it might not have obtained in a world that is otherwise physically like the actual world. Consider such a world w, and suppose that our lemon is one of the objects in w that is not yellow, despite possessing R^y. In both w and the actual world, the fact that the lemon looks yellow can be causally explained in terms of R^y. But obviously, in w, this fact cannot be causally explained in terms of the lemon's yellowness – the lemon is *not* yellow in w. So the lemon would have looked yellow whether or not it was, and this shows – the second argument concludes – that in the actual world the lemon's yellowness is causally inefficacious (see, for example, Tye, 2000, p. 148).

However, this argument is inconclusive. The crucial move is to appeal to a test for causal inefficacy along these lines: if an effect e would have occurred even if instantiated property F had not been instantiated, then F was causally inefficacious with respect to e. That – or some variant of it – is not implausible (see, for instance, Lepore and Lower, 1987; Yablo, 2003). However, given the presence of the chromophysical laws, if the lemon had not been yellow, it would not have had R^y, in which case the test does not show that yellowness was causally inefficacious. A proponent of the argument might revise the test by building more into the antecedent: if an effect e would have occurred even if instantiated property F had not been instantiated, and if the laws in which F figures had not obtained, then F was causally inefficacious with respect to e. Yellowness passes *this* test for inefficacy, but – unlike the simple counterfactual test – the correctness of the more complex test is not at all intuitive, and indeed entirely disputable.

4.2. *Spectrum Inversion*

Another common argument for (P → EP) turns on the possibility of spectrum inversion:

> Take an ordinary object, such as a red apple. It is familiar from everyday experience that such an object can cause phenomenally red experiences of the apple and (in some circumstances) can cause phenomenally green experiences of the apple, without any change in its intrinsic properties. It then seems that there is no obstacle to the existence of a community in which objects with the intrinsic properties of this apple

normally cause phenomenally green experiences. We can even imagine that the very same apple normally causes phenomenally red experiences in one community and normally causes phenomenally green experiences in the other.We can now ask: when a subject in the first community has a phenomenally red experience of the apple, and a subject in the second community has a phenomenally green experience of the apple, which of these experiences is veridical? (Chalmers, 2006, §6)

Chalmers then canvasses four candidate answers: (i) only the experience of the subject in the first community is veridical, (ii) only the experience of the subject in the second community is veridical, (iii) both experiences are veridical, (iv) neither experience is veridical. Against (i) and (ii), he objects that "this imposes an asymmetry on what otherwise seems to be a quite symmetrical situation". Against (iii), he objects that if the apple is both red and green, then a generalization of the argument would show that every object has every color. The only candidate left standing is (iv), and so ($P \rightarrow EP$) follows.

Although Chalmers' official target is R-primitivism, the view that colors are *sui generis* properties plays no role in the argument. The crucial premise is that spectrum inversion is possible, with the apple causing "phenomenally green experiences..., without any change in its intrinsic properties". So the argument is perhaps better viewed as one against the view that colors are intrinsic properties (or, more exactly, *intrinsic enough* to allow for the possibility of spectrum inversion). And this view is quite compatible with the colors being physical properties, for instance.

In fact, physicalist theories of color are sometimes the explicit target of the argument from spectrum inversion. A variant of the argument leans on the actual example of individual differences in color perception, not the hypothetical example of spectrum inversion (Hardin, 1993, pp. 79–80; McLaughlin, 2003; Cohen, 2004); this has the advantage of avoiding controversial claims about possibility. We have replied to this variant of the argument as directed against our own physicalist view (Byrne and Hilbert, 2003a, b, 2004). Without rehashing the details, the reply (adapted to Chalmers' imaginary case, and put on behalf of the R-primitivist) is that the situation is *not* symmetrical. Of course, Chalmers' official *description* is symmetrical, in the sense that it provides no reason for favoring one community over the other. But the description is, from the R-primitivist's perspective, crucially incomplete. Chalmers has of course failed to specify whether the apple is primitive red or primitive green. Once we know *that*, then Chalmers' question about the two communities will be easy to answer.[22]

It might be replied that the introduction of a fact about primitive colors over and above the facts about the disposition of the apple to cause color experiences is to beg the question in favor of the R-primitivist. But this is to forget the dialectical situation. The R-primitivist is simply defending her view against the argument from spectrum inversion; if she is disbarred from appealing to the fact the apple has primitive redness then it is her opponent who stands accused of begging the question.

4.3. *Skepticism and Evolution*

The previous objection is *metaphysical* in character: there is no "truthmaker" for the alleged fact that the apple has primitive redness. But it naturally leads to a related *epistemological* objection. As Chalmers puts it:

> Apart from the unappealing asymmetry, this view [R-primitivism] yields a serious skeptical worry: it seems that we have little reason to believe that we are in a community that normally perceives veridically as opposed to nonveridically. (Chalmers, 2006, §6)

Why? Here is one reason that might be offered. When one looks at an apple, one's evidence for the hypothesis that is red is the fact that it causes "phenomenally red experiences" (or, perhaps more simply, that it looks red). But, if there is a thoroughly contingent connection between the color of the apple and the kinds of experiences it produces (or how it looks) – so, for example, a green apple could produce phenomenally red experiences (or look red) – then the evidence for the hypothesis that the apple is red is rather weak. In fact, it doesn't seem even to *favor* the hypothesis that the apple is red over the hypothesis that it is green. And if it doesn't even do that, then we don't have *any* reason to think that the apple is red.

However, this argument has a highly contentious assumption, namely that our perceptual evidence consists at bottom in facts about our mental states. On a more sensible view of foundational perceptual evidence, as consisting at least partly in facts about our environment, the argument doesn't get off the ground. (See, especially, Williamson, 2000, chs. 8 and 9.)

Fortunately, Chalmers' reason for thinking that R-primitivism leads to skepticism does not rely on any contentious assumption about the nature of perceptual evidence:

> After all, nature and evolution will be indifferent between the two communities above. Evolutionary processes will be indifferent between perceivers in which apples produce phenomenally red experiences, perceivers in which apples produce phenomenally green experiences, and perceivers in which apples produce phenomenally blue experiences. Any such perceiver could easily come to exist through minor differences in environmental conditions or brain wiring. If we accept the reasoning above, only a very small subset of the class of such possible perceivers will normally have veridical experiences, and there is no particular reason to think that we are among them. (Chalmers, 2006, §6)

R-primitivism leads to skepticism, according to Chalmers, for the straightforward reason that if R-primitivism is true, our beliefs about the colors of things could easily have been false, and hence do not amount to knowledge.

Chalmers' argument requires the following two assumptions. Assumption A: there are variety of possible phenotypic long-term "spectrum inversions" that would not materially affect evolutionary fitness. Assumption B: mutations producing genes for spectrum inversion could easily have occurred. Given A, a variety of spectrum inversion mutations would not have been selected against. Given B, spectrum inversion mutations could easily have occurred. So it could easily have happened that many or all humans existing in the 21st century were inverted in one way or another. The desired conclusion, that our beliefs about the colors of things could easily have been false, follows on the further assumption that inversions produce errors about the colors of things. This assumption is not unique to primitivism – it is shared by common versions of physicalism, for example.[23]

Assumption A might be challenged on two grounds. First, it might be argued that all or most inversions would affect evolutionary fitness. However, making this convincing would be both difficult and extremely complicated (for relevant discussion, see Palmer, 1999). A more promising line of objection to A is "philosophical". For instance, one might argue on externalist grounds that an organism could not be spectrally inverted for its entire adult life. Thus Campbell: "what constitutes experiences being experiences of the particular colors they are is their being responses to just those features of the environment" (Campbell, 1993, p. 267). On Campbell's view, it appears, there simply could not be a long-term propensity to respond to red apples with an experience as of a green apple. This is, of course, controversial. But at least A is unobvious.

Suppose we grant assumption A. The mere metaphysical possibility of long-term spectrum inversion that would not be selected against is not enough to show that inversion mutations could easily

have occurred, and so not enough to show that color skepticism is true. For that, we need assumption B, for which Chalmers provides no argument. Moreover, B is dubious.

First, if "inversion mutations" could easily have arisen in human evolution, one might expect to find evidence of the occasional inversion mutation in other species with color vision. (Given A, that such mutations are not beyond the reach of evidence is illustrated by the fact that, on genetic grounds, red–green inversion was once conjectured to obtain in a tiny fraction of the human population.[24]) However, although there is considerable variation in color vision between species, and sometimes within species, none of the known variations is plausibly thought of as an inversion. Typically, these variations have evolutionary explanations as adaptations to features of the environment.[25, 26] This evidence suggests, although it certainly does not prove, that Chalmers' second assumption is incorrect; in any event, there is no positive empirical reason to believe it.

Second, even with assumption A granted, we might fairly conjecture that more-or-less veridical perception is to some extent the default condition, and that widespread perceptual illusion requires an especially elaborate set of background conditions, and hence could not easily have obtained.[27] This presumption of veridicality is shared by "broadly causal" theories of intentionality (Fodor, Millikan, Dretske, Stalnaker) and "interpretational" theories (Davidson, Dennett), which indicates that there is some insight behind it. And this sort of asymmetry between a condition that actually obtains and a possible but highly abnormal condition is found in other areas of philosophy. For example, Chalmers himself argues (in effect) that although "zombies" (physical replicas of ourselves who lack consciousness) are possible, zombies could not easily have arisen in evolutionary history (Chalmers, 1996, ch. 7).

The cautious verdict on assumptions A and B is: not proven. Hence Chalmers' argument does not establish that R-primitivism leads to skepticism.

4.4. *Summary*

According to Chalmers, the only viable form of primitivism is E-primitivism:

> ...this reasoning suggests that primitive properties are not instantiated at all. I think that this is clearly the most reasonable view for a primitivist should take: on this

view, experiences attribute primitive properties, but their objects never possess these properties. (Chalmers, 2006, §6)

We have argued that the common arguments for this conclusion are not compelling: for all they show, R-primitivism is a live option.

5. CAMPBELL AND YABLO: COMPARE AND CONTRAST

Indeed, one might think that R-primitivism is more than a live option. Its reductive realist rivals face difficulties, as does eliminativism. Isn't it the natural and intuitive view – the default theory of color?

In fact, it isn't. This can be brought out by examining what superficially appear to be two similar formulations and defenses of R-primitivism, in well-known papers by Campbell and Yablo. As we will see, there are some crucial differences.

5.1. *Campbell*

In "A Simple View of Colour", Campbell defends a version of R-primitivism he calls the "Simple View". The Simple View is the conjunction of (at least) three theses. The first is:

MIND-INDEPENDENCE Colors are "mind-independent" (and so "they are [not] powers of objects to produce experiences in us"). "I shall equate this view [of colours as mind-independent] with the thesis that they are...the grounds of the dispositions of objects to produce experiences of colour" (Campbell, 1993, p. 178).

This might suggest that the Simple View, although not *identifying* the colors with psychological dispositions, nonetheless holds that there is a close connection between the two. On this interpretation, the Simple View implies that redness, for example, is identical to the "ground" of the disposition to look red to normal perceivers in normal conditions (or something along similar lines). But we take it that this interpretation is incorrect: all Campbell means is that when an object x does have a disposition to look to have color *c*, that x has *c* is (typically) part of the causal explanation of its looking to have *c*. Mind-Independence is, then, near enough equivalent to Causation (see Section 2.1 above).

The second thesis is:

TRANSPARENCY "The real nature [of, e.g., redness] is transparent to us" (p. 178); "colours are...properties with which ordinary observation directly acquaints us...ordinary colour vision is enough for us to know *which* property blueness is, for example" (p. 186).

Despite the slight differences in formulation, we can identify Transparency with Revelation, as explained in Section 2.2. Since Revelation implies Minimal Primitivism, so does the Simple View.

The final thesis is:

SUPERVENIENCE "[W]ithout there being any commitment to any thesis of property identity...colours are supervenient upon physical properties, if only in the minimal sense that two possible worlds which share all their physical characteristics cannot be differently coloured" (p. 178).

This suggests that colors are metaphysically coextensive with physical properties, but that is probably reading too much into this brief statement of supervenience, which Campbell does not elaborate. It seems to be a safe bet, however, that the Simple View implies Metaphysical Determination (the thesis that reflectances, or physical properties more generally, metaphysically determine colors).

Campbell's defense of the Simple View consists in rebutting objections to it. He does not explain why it is to be preferred over other theories of color, presumably because he apparently thinks that the Simple View (or, more likely, the Simple View minus the technical thesis of supervenience) is the position of "common sense" (p. 178). Campbell replies to the explanatory exclusion problem (as noted in Section 3.1), and a variant of the skeptical argument discussed in Section 3.2. He considers one other objection, described as "the central line of objection to the Simple View" (p. 178). It seems to us that this objection is not central at all; in any event, we will set it aside.[28]

5.2. *Yablo*

In his paper "Singling out properties", Yablo defends an account of color that we will call (borrowing a term used slightly differently in Yablo's paper), the 'Naïve View'. According to the Naïve View, redness (for example) is "an intrinsic nondispositional *sui generis* color property" (Yablo, 1995, p. 489), which typically causes experiences as of red objects (p. 487). Further, colors are "nonphysical determinables" of "microphysical determinates" which amounts, near enough, to Metaphysical Determination (p. 487). Thus at first glance the Naïve View looks, like the Simple View, to be MD R-primitivism.

Yablo's defense of the Naïve View is somewhat similar to Campbell's defense of the Simple View. Yablo takes the Naïve View to be the default theory of color, and so holds that the onus of proof

is on its rivals. Like Campbell, Yablo spends most of his paper fending off various objections, in particular – drawing on his earlier work on mental causation – the explanatory exclusion problem.

If the Naïve View is MD R-primitivism, it should imply Revelation. And Yablo does endorse a similar-sounding thesis: "the claim here is that yellowness is *itself* something familiar and known; our ordinary, nonexpert ways of conceiving it tell as good a story as any about what it is" (p. 485). But this is not Revelation, because Yablo's claim is merely that the ordinary ways of conceiving yellowness are sufficient to know *what yellowness is*; it is apparently left open that there are other – "expert" – ways of conceiving yellowness (as, perhaps, a type of reflectance) that are also sufficient for knowing what it is. And when he does mention Revelation – "There is even the view that [our experience of a color] should lay the color's nature completely bare" (p. 490)[29] – he is plainly not endorsing it.

Revelation is not implied by the Naïve View, then: it is compatible with the Naïve View that yellowness has an essence hidden from the ordinary person. What's more, Yablo later argues that often one can know what X is (have an "adequate conception of X") even though one is entirely ignorant of the nature of X. ("[T]he principle that 'one is not obliged to conceive X as F...unless X is F by nature' is definitely mistaken" (p. 493). Applied to yellowness, this suggests that the ordinary ways of conceiving of yellowness – which, according to Yablo, are sufficient for knowing what yellowness is – might not even reveal *part* of that property's nature.

But now there is an exegetical problem: given that Revelation stands or falls with Minimal Primitivism, what are we to make of the passages where Yablo appears to endorse the latter, suggesting that colors are "nonphysical" (p. 488), and "*sui generis*" (pp. 488, 489)?

Take 'nonphysical' first. It is clear that by 'physical' Yablo has something fairly narrow in mind – roughly, property explicitly recognized by the physical sciences (see the discussion of Armstrong on p. 481). Physical properties, on this conception, are not closed under disjunction. In particular, the "disjunctive" reflectance types that reflectance physicalism identifies with the colors are not (in Yablo's terminology) physical. Despite superficial appearances to the contrary, Yablo is not disagreeing with color physicalists.

What about '*sui generis*'? On Yablo's view, the colors are not physical (in a narrow but perfectly standard sense), and neither are they dispositions to affect perceivers. One might well sum this up by saying that the colors are *sui generis*, and there is no obvious reason to take Yablo to mean anything stronger.

On our interpretation, Yablo's Naïve View is non-committal on the matter of Revelation, and non-committal on the matter of whether colors are physical properties. And since Yablo does not seem to have any sympathy with dispositionalism, we may take the Naïve View to be equivalent to the disjunction of Campbell's Simple View and color physicalism.[30]

5.3. *Is R-primitivism the Default View?*

Colors are intrinsic properties of objects like oranges and lemons, and not dispositions to affect perceivers. (At least, this is a point of agreement between Campbell, Yablo, and ourselves.) Further, colors are, as Yablo puts it, "familiar and known"; as Campbell puts it, "ordinary colour vision is enough for us to know *which* property blueness is, for example".[31] If this last claim amounts to Revelation, as Campbell apparently thinks it does, then R-primitivism (or, perhaps, the stronger Simple View) is the default theory of color.

However, as Yablo's discussion shows, the fact that ordinary people know what colors are does not lend any support to Revelation. One can know which property blueness is without knowing everything – and perhaps not anything – about its nature. To borrow one of Yablo's examples (p. 492), the ordinary person ignorant of chemistry is not thereby barred from knowing what salt is.[32]

Revelation will appear to be obviously true if one confuses it with the claim that ordinary visual experience is sufficient to know what colors are. Once that confusion is laid to rest, the status of Revelation is not so clear.

A much better candidate for a default theory of color is Yablo's Naïve View, or the slightly weaker thesis that is the disjunction of R-primitivism and color physicalism. It is now time to face the question of whether R-primitivism should be accepted. The next section argues that it shouldn't be.

6. AGAINST R-PRIMITIVISM

First, we will argue that color vision in non-human animals raises difficulties for any version of R-primitivism. Then we will press another complaint against NC R-primitivism in particular. Finally, we will argue that MD R-primitivism is without any motivation.

6.1. *Against R-primitivism: Animal Color Vision*

Human beings are not the only animals with color vision. Consider, for example, the common goldfish (*Carassius auratus*). Goldfish color vision displays many similarities with human color vision, including opponent organization in the retina, simultaneous color contrast and possibly color constancy (Dörr and Neumeyer, 1997). In spite of these similarities there are substantial differences between the color discriminations made by goldfish and human beings (Neumeyer, 1986; Fratzer et al., 1994). One of the most striking differences is due to the presence in the goldfish retina of a cone-type sensitive to the near ultraviolet (Bowmaker and Thorpe, 1991; Palacios et al., 1998). This cone-type extends the sensitivity of goldfish color vision into a wavelength band that is inaccessible to human vision. Consider two objects that have identical reflectances at those wavelengths to which human color vision is sensitive but which differ in their reflectance in the near ultraviolet. A goldfish will be able to discriminate between these two objects by sight, but to a human being they will be indiscriminable.

How should the R-primitivist describe the discriminatory abilities of the goldfish? One natural and well-motivated description is that goldfish really are responding to colors, albeit not those that human beings can detect. It is unclear, though, whether the R-primitivist can agree, because the claim that goldfish are responding to colors is in some tension with Revelation. If there are goldfish colors, then presumably they have some nature in common with the human variety. The nature of the human colors, then, should somehow make room for goldfish colors. But careful reflection on (human) color experience seems, if anything, to *exclude* the possibility of colors that are not located within the familiar color solid. That is, if the nature of the human colors is revealed to us by color experience, as Revelation claims, then (arguably) goldfish colors do not exist.

Further, unlike reductive realists (physicalists, in particular), there is no lower-level description of the color properties that R-primitivists can use to establish a kinship between the properties detected by goldfish and human vision. For these two reasons, the R-primitivist might try to describe the goldfish differently.

One alternative description is that both human beings and goldfish are responding to the same range of colors but that one group – let it be the latter! – is prone to systematic errors in color discrimination. On this view, two objects that reflect the same light

from the humanly visible spectrum but not in the ultraviolet are the same in color, and when the goldfish discriminates between them it is subject to a color illusion. This view suffers from two related problems. First, the explanation of why one species is right and the other wrong is left incurably mysterious. Second – setting aside the comparison with humans – convicting goldfish of error is not very well motivated, because they are responding to objects in a way that correlates with real physical differences. Of course, humans are not sensitive to these differences, but they are there nonetheless.

There is one other option available to the R-primitivist, namely to deny that non-human animals respond to color at all. On this view, although goldfish are perhaps detecting genuine properties of objects, these are not colors. Only human beings are capable of seeing and responding to color as such; other animals can respond to properties that are more or less well-correlated with color, but they do not have color vision. This view comes in two versions. On the first, each non-human species with so-called "color vision" perceives a family of properties ("c-properties") idiosyncratic to that species. Although there may be similarities in the causal pathways underlying the perception of goldfish c-properties, howler monkey c-properties, and so on, the c-properties perceived by different species are not fundamentally related. This version implausibly supposes that different types of animals use very similar physiological machinery, sensitive to very similar types of environmental features, to detect unrelated properties. On the second version, human beings see primitive colors, while non-human animals merely perceive physical features (reflectance types, say) of objects in their environment. On both versions of the third option, as with the second, it is mysterious how to motivate and justify the special treatment of human beings.

R-primitivism has severe problems in accommodating the facts about the visual behavior of non-human animals. It is worth pointing that plausible versions of physicalism do considerably better. Suppose that colors are reflectance types. Depending on the nature of an organism's visual apparatus, it will be sensitive to some reflectance types but not others. In this way physicalists can account for what all color-perceivers have in common, perception of reflectance types, while at the same time acknowledging that different kinds of color-perceivers may see different colors.

6.2. *Against NC R-primitivism: Permuted Earth*

According to NC R-primitivism, colors and reflectance types are related by contingent chromophysical laws:

NOMOLOGICAL COEXTENSIVENESS (NC) For any color c, there is a reflectance type P such that P is nomologically coextensive with c. Equivalently: it is a law that for every object x, x has P iff x has c.

Let R^{g} be the reflectance type that is identical to greenness, according to reflectance physicalism. Then on the present version of R-primitivism, there is a chromophysical law that for every object x, x has R^{g} iff x is green. Since the chromophysical laws are contingent, they might not have obtained. Further, other chromophysical laws might have obtained instead. If R^{y} is the reflectance type that actually correlated with yellowness, there might have been a chromophysical law to the effect that, for every object x, x has either R^{g} or R^{y} iff x is pink. Yet further, there might have been many counterfactual chromophysical laws. (Of course, denying these additional claims about what is possible would not be *inconsistent* with the contingency of the chromophysical laws, but it is obscure how such denial could be motivated.)

Consider a possible world in which the chromophysical laws are very different from how they actually are, and in which there is a physical replica of Earth – Permuted Earth. On Permuted Earth there are cucumbers, leaves of grass, dollar bills, and chunks of jade, physically exactly as they are on Earth. However, the objects that are green on Earth are not green on Permuted Earth. Instead, on Permuted Earth these objects have a multitude of colors: cucumbers are pink, leaves of grass yellow, dollar bills blue, and jade purple. And likewise for all other objects: blood drops are green, fire trucks are pink, tomatoes are black. An example of a chromophysical law obtaining on Permuted Earth is this: for every object x, x is pink iff x has $R^{g}{}_{7}$ v $R^{r}{}_{4}$ v $R^{b}{}_{13}$, ... Here $R^{g}{}_{7}$ is one of the determinate reflectances (in fact the reflectance of cucumbers) comprising the reflectance type that on Earth is correlated with greenness, $R^{r}{}_{4}$ is one of the determinate reflectances (in fact the reflectance of fire trucks) comprising the reflectance type that on Earth is correlated with redness, and so on.

On Permuted Earth, life and its evolution proceed much as they do on Earth. On Permuted Earth, trichromatic color vision (or at any rate something physically just the same as trichromatic color vision) evolves in primates, and the smartest primate of all writes philosophy,

invents the iPod, and so on. (Without begging any questions about the mind/body problem, we may assume that the humans on Permuted Earth are mentally alike ourselves, at least with respect to mental states that do not involve the representation of colors.) What should we say about the "color vision" of the humans on Permuted Earth? Do they see colors? Do the pink cucumbers on their planet look green to them?

The answers to these questions are unobvious. Perhaps the inhabitants do not enjoy *color* experiences at all. But one thing is for sure, the pink cucumbers do *not* look *pink* to the humans on Permuted Earth. Given the Permuted Earthers' physical kinship with ourselves, they are completely unable to classify the pink objects together on the basis of vision; conversely, they are readily able to distinguish by sight, in a variety of normal illuminants, objects that are exactly the same shade of pink. So, while there is perhaps no widespread perceptual error on Permuted Earth, its inhabitants do not see things in their true colors.[33]

In fact, as can be seen by a little experiment, for almost every way of constructing a Permuted Earth, the moral will be the same: the inhabitants will be blind to the colors of many (and often all) objects.

According to the NC R-primitivist, we see things in their true colors. If the chromophysical laws had been of the Permuted Earth sort, we would not have been so lucky, because the evolution of color vision is entirely insensitive to the particular character of the chromophysical laws. Hence, the NC R-primitivist must admit that there is some kind of pre-established harmony or bizarre cosmic coincidence. And – unless we have stumbled upon a new proof of the existence of God – pre-established harmony is not hypothesis to be taken seriously. So Permuted Earth is not possible, which is to say that NC R-primitivism is false.

Unlike Chalmers' argument, the Permuted Earth argument does not rely on speculations about mutations in the genes for color vision. Neither is the Permuted Earth argument *epistemic*. The claim is not that NC R-primitivism implies that we do not know whether some Permuted Earth scenario obtains. Indeed, if NC R-primitivism is true, then although the chromophysical laws *could have* been otherwise, they could not *easily* have been otherwise – a law is precisely the sort of thing that could not easily have been otherwise. Hence there is no reason to suppose that if NC R-primitivism is true, then our beliefs about the colors could easily have been false, and so no evident reason for thinking that this theory leads to skepticism.

Rather, the point is that the R-primitivist is forced to suppose that there is a pre-established harmony for which there is no explanation.

6.3. *Against MD R-primitivism: Motivation*

According to MD R-primitivism, reflectance types metaphysically determine colors:

METAPHYSICAL DETERMINATION (MD) For any color *c*, there is a reflectance type P such that P metaphysically necessitates *c*. Equivalently: it is metaphysically necessary that for every object x, if x has P, x has *c*.

Granted that cucumbers, dollar bills, and chunks of jade are green, according to MD it is not possible for objects with the same reflectances not to be green. That is, if MD R-primitivism is true, a Permuted Earth scenario is not possible, and so the previous objection does not apply.

To find an objection that does apply, consider why one might be tempted by Minimal Primitivism. In Section 2.2, this was explicated as the claim that if 'It is in the nature of the colors that *p*' is true, then '*p*' is a *purely chromatic* sentence – 'Pink is desaturated red', 'There is no transparent white', and so on. Also in Section 2.2, it was noted that Minimal Primitivism is entailed by one half of Revelation, namely:

SELF-INTIMATION If it is in the nature of the colors that *p*, then after careful reflection on color experience it seems to be in the nature of the colors that *p*.

So one route to Minimal Primitivism is via Self-Intimation; however, the latter thesis is no more obvious than Minimal Primitivism itself. Why, then, might Minimal Primitivism appear attractive? Here is a plausible conjecture. The connection between colors and properties specified in other terms (as reflectance types, for example) seems contingent. Surely there could have been a *red* apple that *lacks* R^r, and surely there could have been a *green* apple that *has* R^r! (Compare the apparent contingency between pain and "c-fiber firing".[34]) Now if it is in the nature of the colors that redness $=$ R^r (for example), then it is necessary that redness is R^r. Given the apparent contingency, that redness $=$ R^r will strike us as not necessary (and, hence, as not true), and so as not in the nature of the colors. Generalizing, there will be some inclination to suppose that if 'It is in the nature of the colors that *p*' is true, then '*p*' is purely chromatic. (It does not strike us as *contingent* that scarlet is a shade of red.) But this is just Minimal Primitivism.

Pending some other motivation for Minimal Primitivism, we may assume that its only source is the apparent contingency between colors and properties specified in other terms. But then the motivation for Minimal Primitivism simultaneously undermines MD R-primitivism, which holds that the correlation between colors and physical properties is not contingent. Hence, when the foundations of Minimal Primitivism are exposed, this reveals that MD R-primitivism lacks support entirely.[35]

Once it is apparent that the standard objections to a realist version of color primitivism are of little force, it might seem that only a philosophical fetish for reductionism stands in its way. We have argued that this is not so: on closer examination, R-primitivism is unacceptable. Theorists of color should return to the usual suspects.

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NOTES

[1] We review most of these options and give an indication of their strengths and weaknesses in Byrne and Hilbert (1997b, 2003a).

[2] McGinn (1996) defends a view that is relativist in spirit, if not in letter, namely that colors are necessarily coextensive with (but not identical to) dispositions to look colored to normal perceivers in normal conditions. McGinn accepts AR, because he thinks that the colors themselves are not relational. However, he rejects this stronger version of AR: colors do not supervene on relational properties, where the relata are perceivers and/or viewing conditions. In rejecting this stronger version of AR, he is an exception among primitivists. (Note that primitivism provides no *special* reason for favoring AR: *sui generis* properties may presumably also be relational.)

[3] In Byrne and Hilbert (1997b, 2003a), 'primitivism' was defined as (approximately) R-primitivism. In taking primitivism to be compatible with eliminativism we are following the better usage of Chalmers (2006).

[4] Byrne and Hilbert (2003a) extends reflectance physicalism to include the colors of light sources and transparent volumes.

[5] In this paper a "physical property" is either a property quantified over by the physical sciences (taken to exclude *color* science, whose proprietary vocabulary includes color terminology), or a disjunction of such properties. Issues concerning the completeness and correctness of the physical sciences, which arise in connection with physicalism about the mind, are not relevant here. Neither is the metaphysics of properties, but we assume for convenience of exposition that properties exist and are closed under disjunction. Given our stipulative definitive of 'physical property', (a) it

is an open question whether colors are physical properties and (b) Minimal Primitivism implies that they are not. Some primitivists might reject our usage, preferring to call *sui generis* colors 'physical properties'; as far as we can see, nothing of any substance turns this issue.

[6] There is also the opposite danger of taking Revelation's evidential base to be too broad. For example, most thinkers since antiquity have reached the conclusion that there is some very intimate (perhaps even essential) connection between light and color, and they have done this on the basis of ordinary visual experience, not scientific investigation. Presumably this does not fall within the scope of Revelation because the reasoning relies on information that intuitively is not solely supplied by "color experience".

[7] We are making various assumptions concerning the operator 'It is in the nature of the colors that' (abbreviated as 'INC'). The first is uncontroversial (at least for those who claim to understand talk of essences): $\ulcorner \mathrm{INC}\alpha \urcorner \models \ulcorner \Box\alpha \urcorner$. The second is implicit in the earlier explanation of Revelation: for some sentences α, even containing color terms, $\ulcorner \Box\alpha \urcorner \not\models \ulcorner \mathrm{INC}\alpha \urcorner$. The third assumption has some intuitive motivation, but is mostly made for convenience in order to avoid distracting problems that arise if certain negative claims about the colors are classified as being in their nature. The assumption is that if redness (e.g.) is *not* a reflectance type R (or disposition D, etc.), then ~INC redness $\neq$ R, and if redness is *not* metaphysically determined by reflectance type R (for short, ~R$\Rightarrow$redness), then ~INC ~R$\Rightarrow$redness; moreover, if redness is not a reflectance type or physical property of any sort but *is* metaphysically determined by reflectance type R (i.e., R$\Rightarrow$redness), then ~INC R$\Rightarrow$redness. (Note that the third assumption entails the second.) For reasons of space, we will not try to show that the third assumption can be dropped without affecting the overall argument of this paper.

[8] The weaker reading of Revelation also has this result (Byrne, 2001).

[9] On one view, which we assume to be false here, color nouns non-rigidly designate whatever fills the "color role" implicitly defined by our folk theory of color (cf. Jackson, 1996, 2003; see also Byrne and Hilbert, 2003b). Suppose that certain reflectance types fill that role. Then 'Colors are reflectance types' is true but contingent, and hence it is not in the nature of the colors that they are reflectance types. (Jackson's view is actually more nuanced: he thinks that it is a vague matter whether color nouns designate rigidly (personal communication).)

[10] Boghossian and Velleman's case for Eliminativism (Boghossian and Velleman, 1989, 1991) implicitly appeals to Self-Intimation to rule out specific reductionist theses (see Johnson, 1992, p. 169, fn. 6). After (in effect) arguing for Minimal Primitivism, they then reach Eliminativism by tacitly assuming that R-primitivism is false.

[11] This list of examples serves to give an informal and vague characterization of a purely chromatic sentence, and no more precise characterization will be attempted. (If one wants to extend the range of allowable vocabulary slightly, so that 'Red is a warm color', for example, counts as purely chromatic, this will not affect the argument.) For convenience, numerically quantified sentences such as 'There are 5 purple things', and some sentences logically equivalent to purely chromatic sentences, such as 'Brown is blackened orange and everything self-identical', are not counted as purely chromatic. Note that if 'p' is purely chromatic, so is '~p'.

[12] As mentioned in the text, this inference from 'S[~INCp]' (i.e. 'It seems not to be in the nature of the colors that p') and 'S[INC~p] $\supset$ INC~p' (from Infallibility), to '~p',

where '*p*' is purely chromatic, can be supported by example. Note that adding the premise 'S[~INC*p*] ⊃ S[INC~*p*]' makes the inference formally valid. (Assuming, of course, that '~*p*' is formally implied by 'INC~*p*'.) And this extra premise follows from the assumption of *Seeming Chromatic Completeness*, that every purely chromatic proposition (one expressed by a purely chromatic sentence) is such that either it or its negation seems to be in the nature of the colors. (Proof: suppose that S[~INC*p*]. It follows (we may assume) that ~S[INC*p*]. By Seeming Chromatic Completeness, S[INC*p*] v S[INC~*p*]. Since ~S[INC*p*], it follows that S[INC~*p*]. Hence, S[~INC*p*] ⊃ S[INC~*p*].) (Seeming Chromatic Completeness should be distinguished from the thesis called *Completeness* in the next paragraph in the text, that S[INC*p*] v S~[INC*p*].)

It is worth noting that, against the background of Revelation, Seeming Chromatic Completeness is equivalent to *Chromatic Completeness*, that every purely chromatic proposition is such that either it or its negation is in the nature of the colors. (It follows from the premise that S[INC*p*] v S[INC~*p*] and Infallibility that INC*p* v INC~*p*, and it follows from the premise that INC*p* v INC~*p* and Self-Intimation that S[INC*p*] v S[INC~*p*].) For a discussion and justification of Chromatic Completeness in a different context see Hilbert and Kalderon (2000).

[13] Smart's paper was not published until 1975.

[14] See also Cornman (1977), which defends something close to R-primitivism about pain.

[15] Johnston's in-progress manuscript *The Manifest* is also sometimes cited as an endorsement of R-primitivism.

[16] For example, the arguments against physicalism about color in Boghossian and Velleman (1991) would appear to work equally well, mutatis mutandis, against physicalism about perceived shape.

[17] For other versions of this objection, see Johnston (1992, p. 139), and Chalmers (2006).

[18] For discussion, and an attempt (which we lack space to discuss) to restrict the scope of this "generalization argument", see Kim (1998, pp. 77–87, 112–120).

[19] Watkins (2005) discusses the exclusion problem at length and argues, contrary to what is often supposed, that R-primitivism is much better placed than physicalism to solve it. See also note 30 below.

[20] Yablo (1992, p. 257) gives a similar example where the realized and realizer properties are both colors.

[21] As Broackes (1992, p. 192) notes, Putnam's (1975) famous square peg and round hole example makes a similar point.

[22] The possibility of spectrum inversion could be questioned (see the following section), but in our view this is not the fundamental flaw in the argument.

[23] McGinn (1996), however, is one R-primitivist who does not accept this further assumption.

[24] This hypothesis of "pseudonormal vision" now seems unlikely for empirical reasons. For some discussion and references, see Byrne and Hilbert (2003a, p. 19).

[25] For some representative studies on vertebrates see Lythgoe (1979, 1984), Mollon and Regan (1999), Sumner and Mollon (2000), Dominy et al. (2001), Regan et al. (2001).

[26] There is variation among the human cone pigment genes that has no known functional significance, but this is because the mutations have no effect on how the visual system responds to light (Nathans, 1999; Neitz and Neitz, 2000).

[27] One might argue that there actually is widespread systematic misrepresentation of colors, on the grounds that all human beings are yellow-blue color blind for very small stimuli viewed with central vision. (This is because human eye contains no S-cones in the central fovea.) However, setting aside the fact that this does not result in false beliefs about the colors of things in normal circumstances, it is controversial whether color blindness involves any kind of misrepresentation.

[28] According to the objection, a component of the Simple View implies that colors are mind-dependent, and hence the Simple View is inconsistent (Campbell, 1993, pp. 178–179). However, as far as we can see, this objection simply equivocates on 'mind-independent'.

[29] The "laying bare" formulation is an allusion to Johnston (1992, p. 139).

[30] There is a complication. Yablo's account of causal relevance in his 2003 paper requires causally relevant colors to be "natural" properties, or at least more natural than Lewisian orthodoxy would take them to be, if physicalism about color were true. Yablo could either take this to motivate the Simple View or, alternatively, to motivate a non-Lewisian account of naturalness on which a natural property need not have a simple definition in terms of fundamental physics.

[31] Descartes disagrees: "If someone says he sees colour in a body...this amounts to saying that he sees...something there of which he is wholly ignorant, or, in other words, *that he does not know what he is seeing*" (Descartes, 1644/1985, part I, p. 68, our italics).

[32] It is worth noting that Yablo is *not* making the (also correct) point that 'S knows what X is' is context sensitive. The context sensitivity of this sort of expression neither implies nor is implied by the claim that colors (or condiments) are "familiar and known".

[33] Given the contingency of the chromophysical laws, we can stipulate that the only colors instantiated on Permuted Earth are of the human variety. So, on Permuted Earth, nothing has a goldfish color (see the previous subsection).

[34] For more on the comparison, see Byrne (2006).

[35] One might think that our discussion has exposed yet another position, half-way between MD R-primitivism and reflectance physicalism, that avoids the difficulties besetting both. On this view (call it 'R-semiprimitivism'), (a) colors are metaphysically determined by but are not identical to reflectance types; (b) Minimal Primitivism (and so Self-Intimation) is false; (c) Infallibility is true. R-semiprimitivism obviously avoids the problems just raised for MD R-primitivism and NC R-primitivism, and it might seem that it avoids the problem for reflectance physicalism mentioned earlier in Section 4, namely that of accounting for the "qualitative nature" of color. We lack space to discuss this in detail but, in brief, R-semiprimitivism isn't really another alternative. According to R-semiprimitivism, the colors have hidden essences (because Self-Intimation is false). Consistently with this, the R-semiprimitivist claims to (somehow) respect the "qualitative nature" of color. And however she manages to pull off this feat, the reflectance physicalist can do likewise.

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