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Color and Similarity[1]

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1 Introduction

Anything is similar to anything, provided the respects of similarity are allowed to be gerrymandered or gruesome, as Goodman observed.[2] But similarity in non-gruesome or—as I shall say—*genuine* respects is much less ecumenical. Colors, it seems, provide a compelling illustration of the distinction as applied to similarities among *properties*.[3] For instance, in innumerable gruesome respects, blue is more similar to yellow than to purple. But in a genuine respect, blue is more similar to purple than to yellow (genuinely more similar, as I shall sometimes put it).

Genuine similarity claims about the colors are sometimes held to pose a serious problem for physicalism about color: the view that colors are physical properties of some kind.[4] The problem comes in slightly different varieties, but the central argument can be put as follows. If colors are physical properties, then these physical properties must stand in the required genuine similarity relations. And now it looks as if platitudes like the one with which we began are hostage to the discoveries of color science, which is surely absurd. It is not a *conjecture* that blue is genuinely more similar to purple than it is to yellow, awaiting confirmation (or—horrors—disconfirmation) by the experts: we know it for certain simply on the basis of ordinary visual experience.[5] (For arguments along these lines see Johnston 1992, pp. 149-54; Boghossian and Velleman 1991, pp. 116-25; Maund 1995, p. 146, p. 157[6])

This kind of argument has also been made using a phenomenon related to color similarity. Some hues are *binary*: every shade of purple, for example, is a *perceptual mixture* of red and blue, that is, both bluish and reddish.[7] The four *unique* hues (red, yellow, green and blue) have shades that are not mixtures in this sense: *unique yellow* is a shade of yellow with no trace of any other hue. If colors are physical properties, then "these physical complexes [i.e. properties] must admit of a division into unique and binary complexes" (Hardin 1993, p. 66). Hardin evidently thinks there is no such division between physical properties, but at the very least the argument threatens to undermine the physicalist's warrant for believing that orange is a mixture of red and yellow: maybe, when the right physicalist identification is made, orange will turn out to be a "unique complex", and so not a binary color at all![8]

I shall argue that these sorts of considerations do not pose a threat to physicalism. Defending physicalism, though, is not my primary purpose: rather, I mainly want to explore some interesting questions about visual representation. For the most part, the focus will be on the first argument—the argument from similarity.

Before we start, some preliminaries. First, I assume the common view that visual experiences have propositional contents (see, e.g., Evans 1982, p. 226; Peacocke 1983, ch. 1). It might visually appear that there is a red circle at some location. The subject's experience is *veridical* if there is a red circle at that location, and *nonveridical* otherwise. The experience *represents* that there is a red circle at that location, and this proposition is the *content* of the experience (of course this involves some simplification, because in a realistic case the content of an experience is considerably richer).

Many questions arise at this point. Should perceptual content be treated along Fregean, Russellian, or other lines? Is perceptual content importantly different from the content of propositional attitudes like belief and desire, or from the content of sentences? Relatedly, is the content of experience "non-conceptual"?[9] Fortunately, I think I can get away without answering any of these questions.[10]

But I must enter a caution about perceptual content and language. Everyone who holds that experience has propositional content agrees that there is some difficulty in precisely specifying an interesting fragment of the content of an experience in words. There are different explanations for this fact. On the one hand, perhaps it would take too much ink to do the content of experience justice. Or perhaps the problem is that natural languages lack certain special items of vocabulary, with which they could in principle be enriched. Or perhaps the content of language and the content of perception are fundamentally different (on one view, the content of language is Fregean, while the content of perception is Russellian[11]). We will have to muddle along without investigating these matters. So when we get to considering some explicit proposals for the content of color experience, a pinch of salt will help.

Second, for simplicity I shall restrict attention to hue, ignoring the other dimensions—saturation, lightness, and possibly others (like "warmth")—along which colors vary. Given this simplification, we can ignore three-dimensional color similarity space and concentrate on the hue circle, proceeding from red through orange to yellow, olive, green, turquoise, blue, purple, and back to red.

Third, it will be useful to have a neutral expression for these facts: a typical subject with normal color vision would take an utterance of 'Red is more similar to

orange than to green' to be true; she would arrange a suitable selection of colored chips in a circle; she would say that a raspberry is more similar in respect of color to a strawberry than to a blueberry, and so on. Call them the *similarity phenomena*. This, to emphasize, is not to explain anything, but rather to label what needs to be explained.

2 The scope of the argument from similarity

The argument from similarity uses only this part of the physicalist's view: empirical investigation into the nature of the colors could undermine the claim, for example, that orange is more genuinely similar to red than to green. Thus the argument from similarity could be deployed against other theories of color that share this assumption. According to Johnston, though, *dispositionalism*—the view that colors are dispositions to look colored—can evade the argument:

> If teal and turquoise were categorical microphysical properties then any essential and intrinsic similarity between them would have to be a similarity in some higher-order microphysical respect. What we know simply on the basis of perception is not sufficient to know that there is such a similarity.
>
> However, if teal is essentially the disposition to manifest a certain appearance Te and turquoise is essentially the disposition to manifest the appearance Tq then teal and turquoise will be essentially and intrinsically similar if these two manifestations are similar. *That these dispositions have similar manifestations is a fact available to us in visual perception*. (1992, pp. 152-3, Johnston's emphasis)

According to Johnston, “the appearance Te” and “the appearance Tq” are similar, and by this he clearly means that they are “essentially and intrinsically similar” (the principle that dispositions are “essentially and intrinsically similar if their two manifestations are similar” would have no plausibility at all if the second occurrence of ‘similar’ was not qualified in the same way as the first). And by ‘essentially and intrinsically similar’ Johnston means (at least) *genuinely similar*.[12] Further, he thinks that this genuine similarity between “the appearance Te” and “the appearance Tq” is “a fact available to us in visual perception”.

What is “the appearance Te” supposed to be? Johnston doesn’t say, but given other passages in his paper, there are only two candidates: a type of sense-datum, on the one hand, and the visual experience as of a teal object, on the other. And of these two, the first seems to fit best with the text. This is problematic, not least because the existence of sense-data is debatable, to put it mildly. The second candidate, however, is not much better. Intuitively, it gets things the wrong way round. If we have opinions at all about salient similarities (genuine or otherwise) holding between our *color experiences*, that is surely because we take such similarities to be induced by the apparent similarities between the *colors*.[13] Why is *the experience* as of a teal object similar to *the experience* as of a turquoise object? Because *teal* is similar to *turquoise*.[14] This similarity claim about properties justifies the similarity claim about experiences, not vice versa. Johnston’s appearances, then, either arguably don’t exist, or else similarity claims about them presuppose what they are supposed to explain, namely similarity claims about the colors.

But let us set this objection aside. The question Johnston is addressing is whether we can know that teal and turquoise are genuinely similar on the basis of ordinary visual

experience. In effect, his answer is in two parts. First, he says that if dispositionalism is true, the problem is reduced to the problem of how we can know that the "appearances" Te and Tq are genuinely similar on the basis of ordinary visual experience. We have just been discussing some difficulties with this first part, the claim that the original problem reduces to one about appearances. The second part of Johnston's answer is that we *can* know that the appearances Te and Tq are genuinely similar on the basis of ordinary visual experience. Now, if the argument from similarity has any force against physicalism about *color*, it has equal force against physicalism about *appearances.* (The argument would run: we are certain that Te and Tq are genuinely similar, but if Te and Tq were physical, this judgement could be overturned by an empirical discovery, which is absurd, so Te and Tq aren't physical.) Therefore Johnston must be assuming that physicalism about appearances is false. More generally, he must be taking appearances to have no hidden essence—physical or otherwise—that could confute, for example, the claim that Te is genuinely similar to Tq.[15]

It is here that two worries arise. First, it isn't at all clear that we have the required special access to the nature of *anything*—even "appearances". Second, once we've got as far as contemplating that ordinary visual experience gives us knowledge of genuine similarity claims about "appearances", why not cut out these middlemen and go straight to the colors themselves? Such an alternative position rejects dispositionalism and physicalism, and simply says that the *colors* enjoy a privileged epistemological status. This is *primitivism*, defended by Campbell (1993), Yablo (1995), and McGinn (1996).[16]

It is helpful to think of the primitivist as finding some truth in classical sense-datum theory. He rejects the claim that sense-data are perceptual intermediaries standing

between us and external things: he thinks that a certain bulgy red sense-datum is in fact the facing surface of a tomato. He agrees, though, that we have some sort of special epistemic access to sense-data, thus externalized. Of course, he *doesn't* think we have a guarantee that sense-data (i.e. surfaces of tomatoes and the like) exist or have the properties that they appear to have. But he does hold that we have a special access to the *apparent properties* of our sense-data. The access may be partial (leaving some part of the nature of the property unrevealed), or it may be total. The kind of primitivist who thinks the access is total would agree with Russell in *The Problems of Philosophy* that the apparent brownness of the table (for Russell, the actual color of a sense-datum) is known "perfectly and completely…no further knowledge of it itself is even theoretically possible" (Russell 1912, p. 25).[17]

What's so bad about primitivism? Johnston has an answer:

> [W]hen it comes to the external explanatory causes of our color experiences, psychophysics has narrowed down the options. Those causes are either non-dispositional microphysical properties, light-dispositions…or psychological dispositions (dispositions to appear colored) with microphysical or light-dispositional bases. (1992, p. 139)

Now, if objects are colored, colors cause our color experiences. More exactly, the fact that a certain canary is canary yellow, for example, "causally explains our visual experiences as of canary yellow things" (p. 138). Therefore, Johnston concludes, assuming objects are colored, and concerning the options just enumerated:

> [W]e must look among these properties if we are to find the colors. (p. 139)

But now it is not at all obvious why psychophysics hasn't "narrowed down the options" when it comes to the *appearances*. The appearances presumably do causal explanatory work (for example, they might be the internal explanatory causes of certain color discrimination behavior). So why aren't they neural entities of some kind?

There is, of course, a standard reply to this sort of question: the phenomenon at hand stands in a very intimate relation to physical properties, events, or facts, without standing in the most intimate of all relations, identity. Instead, the relation is one of supervenience, or perhaps constitution. If this sort of reply can work in the case of the appearances, then it is hard to see why it isn't available in the case of the colors. Hence if Johnston can successfully defend *appearances* from the threat of reduction, the primitivist can defend his *colors* likewise.[18]

Suppose, though, that the defence of supervenience or constitution without identity fails.[19] Then primitivism and Johnston's brand of dispositionalism fall together. And other varieties of dispositionalism appear to be just as vulnerable to the argument from similarity as physicalism.[20] Therefore, if the argument from similarity goes through, the only theory remaining is *eliminativism*: although objects *look* colored, in fact they *aren't* colored.

Summing up, the lesson of Johnston's defence of dispositionalism against the argument from similarity is that the scope of the argument is really very broad. If it works against physicalism, it works against dispositionalism, by forcing the dispositionalist to

espouse doctrines about the objects of perception and their transparency to the mind that make primitivism much more attractive. Thus the only realist theory of color left standing is primitivism. Hence the proper conclusion of the argument from similarity is that either primitivism is true or color is a perfectly monstrous illusion.

3 Epistemological complications removed

The argument from similarity, as I have presented it, tries to show that, if colors were physical properties, our epistemic entitlement to color similarity claims would be less secure than it evidently is. And here there seems to be some room to wiggle. Perhaps the similarity claims are defeasible after all, or perhaps the inference from physicalism to defeasibility is suspect. Then again, perhaps the argument from similarity could be strengthened to show that, if physicalism is true, then ordinary visual experience gives us *no* reason—not even a highly defeasible one—to believe that orange is more similar to red than to green.[21]

Although these epistemological complications are of considerable interest, they can be ignored here, because we can be completely confident that any plausible physicalist candidates for the colors do *not* stand in the required genuine similarity relations.[22] As Johnston observes, there are only two: types of light-reflecting/emitting dispositions, and the microphysical bases of such dispositions. Assuming that our color experiences are mostly veridical, light-reflecting/emitting dispositions at best stand in similarity relations that are very feeble approximations to the desired ones, while the microphysical bases of such dispositions are hopelessly heterogeneous.[23]

4 A related objection to physicalism, and Lewis's reply

In the course of defending physicalism about color, Lewis considers an objection that is closely related to the argument from similarity:

> *Objection*: Some ostensible facts about the colours—for instance, that there cannot be a reddish green, or that there cannot be a shade of yellow that is closer to various shades of blue than it is to any other shade of yellow—are best explained in terms of the way our colour vision works, rather than in terms of relations between physical properties of surfaces. Then if colours are physical properties of surfaces, how can these facts of exclusion and proximity be facts about colours?
>
> *Reply*. Our account provides a correspondence between colours and colour experiences…Whatever form it takes, the correspondence yields relations among colours in the image of relations among colour experiences (or vice versa). So no matter where the relations of exclusion and proximity may originate, in the end we have them twice over: as relations among colour experiences and also as relations among the corresponding colours. (1997, pp. 339-40)

Thus the impossibility of reddish green (if indeed this is impossible) is explained, according to Lewis, if it is impossible to have an *experience* of reddish green, because "reddish green is by definition the surface property that typically causes experiences of reddish green" (p. 330). If there cannot be any such experiences, there's no such surface property.[24]

Let us put the example of yellow and blue in terms of similarity: no shade of yellow is more similar to any shade of blue than it is to any other shade of yellow. What is Lewis's treatment of this case? He doesn't explicitly say, but on one interpretation Lewis is claiming that the similarities among the shades are the image of the (genuine) similarities among the *experiences* of the shades. This is a physicalist version of Johnston's reply to the argument from similarity (teal and turquoise are similar because "the appearance Te" is genuinely similar to "the appearance Tq"), and it succumbs to the main objection developed in section 2 above.[25]

On an alternative—and more plausible—interpretation, that no shade of yellow is more similar to any shade of blue than it is to any other shade of yellow is explained by the fact that one cannot *experience* a shade of yellow y_1 as more similar to a shade of blue *b* than to another shade of yellow y_2.

However, this explanation does not help rebut the argument from similarity (and perhaps Lewis does not think otherwise). The explanation concedes that when one experiences two shades of yellow, y_1, y_2 and one of blue, *b*, y_1 and y_2 are experienced as more similar to each other than either is to *b*. But what does this mean? Offhand, it seems to be a claim about the content of visual experience: the proposition that y_1 and y_2 are more similar to each other than either is to *b* is visually represented. Similar in what respect, though? A *genuine* respect? For all that has been said, the answer might be yes. Suppose that is the right answer: visual experience informs us that y_1 and y_2 are more *genuinely* similar to each other than either is to *b*, and likewise for the other shades of yellow and blue. When we assert, for example, that lemon yellow is more similar to saffron yellow than to ultramarine, we are endorsing this testimony of experience. And if

colors are physical properties these platitudes about similarity might be (absurdly) refuted by color science.

5 Jackson's suggestion

Jackson is also a physicalist about color. He recognizes that the physical properties he identifies with the colors are most unlikely to stand in the right genuine similarity relations. And "[t]his looks like trouble":

> For it is plausible that colour experience, in addition to representing objects as having properties which are causally responsible for these objects looking coloured, also represents these properties as occupying certain places in the three-dimensional color array (red is opposite green, orange is nearer red than green, etc.). (1998, p. 111)

Here Jackson is proposing that visual experiences, in addition to representing *particulars* as having various properties, also represent *properties* as standing in various similarity relations. So, for example, a standard visual experience of a tangerine, a strawberry, and a cucumber represents those objects as being orange, red and green, and (presumably according to Jackson) *also* represents that the property orange is more similar to the property red than to the property green.[26]

This is an important claim, which we will examine in the following section. For the moment, assume that it is correct. Now, if visual experiences represent that colors stand in various *genuine* similarity relations then, as Jackson says, physicalism is in trouble. At the very least, it will have to face the possibility that visual experiences are

seriously illusory—they falsely represent that colors stand in various genuine similarity relations. However, Jackson sees a chance for escape:

> I think, though, that we need to ask: In what sense does, for instance, looking red represent objects as having a property more like the property looking orange represents them as having than does looking green; in what sense is orange as represented in experience more like red as it is represented in experience than it is like green as represented in experience? (1998, p. 111)

Jackson is wondering, in effect, whether the sense in which experience represents orange as more similar to red than to green might be perfectly consistent with orange's not being more *genuinely* similar to red than to green. He briefly considers and rejects the following suggestion:

> A clearly wrong answer would be to say that it is somehow 'more' true or more obvious that orange is a different colour from green than that it is a different colour from red. It is certainly true and completely obvious *both* that red is different from orange and that red is different from green. (p. 111)

Then he gives his own proposal:

> The only alternative seems to be to borrow, in one form or another, from behavioural psychology by analysing the needed sense in terms of *jnds* (just

> noticeable differences). Roughly, the sense in which orange is closer to red than it is to green lies in the fact that it takes more jnds [just noticeable differences] to get from orange of a given saturation to green of the same saturation than to red of the same saturation. But in *that* sense, or anything roughly like it, the physical properties do stand in the right similarity relations. They induce the relevant behavioural relationships. More generally, the point is that if we can, as seems plausible, understand the three-dimensional array, the colour solid, in terms of suitably scaled jnds, then the nature of the array will not be trouble for the primary quality view [i.e. physicalism]. (p. 111; see also Jackson 2000, p. 162)

Jackson does insert the qualification 'roughly' a few times, and prefixes 'scaled jnds' with 'suitably', so we shouldn't fuss about any mismatch between comparative distance in jnds and similarity.[27] The spirit of his proposal seems to be that the colors stand in various similarity relations because "the physical properties [i.e. the colors]…induce the relevant behavioural relationships". Spelling this out further: the colors are similar because instantiations of the colors before the eyes induce "relevant behavioural relationships". The details of the behavioral relationships don't matter, at least as far as Jackson's basic idea is concerned: they might involve threshold discriminations, as Jackson suggests, or alternatively they might involve the arrangement of colored chips in a salient order (the second alternative, unlike the first, is at least easier to rig to yield the right answers). In any event, Jackson's conclusion is clear enough: when visual experience informs us that orange is more similar to red than to green, this has nothing to

do with whether these three properties are genuinely similar, and so poses no problem for physicalism.

If we go over Jackson's suggestion carefully, filling in the necessary details, I think we can see that he hasn't solved the problem. According to Jackson, visual experience represents that colors stand in certain similarity relations. One proposition, in particular, that is represented by visual experience is a certain proposition S:

(S) Orange is more similar (in respect X) to red than to green.

This isn't a *complete* specification of the proposition S—for that, we need to know how to fill in the letter 'X'. We can think of Jackson's main opponent as claiming that S is the proposition that orange is more *genuinely* similar to red than to green. Jackson disagrees. However, although we know what he thinks S *isn't*, he doesn't tell us what S *is*. (It would not be at all plausible to say that S is the proposition that orange is more similar in so-and-so behavior-inducing respects to red than to green: *that* is not the way the colors look.) Instead, Jackson says that necessarily S is true if such-and-such colored objects before the eyes would induce us to behave in such-and-such ways, that these colored objects would indeed induce this behavior, and that, therefore, S is true.

Keeping things as simple as possible for illustration, suppose that the relevant behavior in the case of orange, red, and green simply involves placing an orange chip closer to a red chip than to a green chip. So the claim to be examined is that, necessarily, S is true if an orange chip, a red one, and a green one, placed before the eyes, would induce this behavior. Naturally various provisos are needed: for example, the subject

must be suitably cooperative and must understand the instructions. And we should further require that the subject *veridically* perceives the colors of the chips. (If the subject misperceived the orange and green chips, say, as having the same color, then the wrong sorting behavior would result.)

Should we add to our list of provisos that the content of the subject's visual experience include the proposition S? Yes, we should. Remember the subject is supposed to behave in the way appropriate to someone who thinks that orange is more similar to red than to green. Now Jackson's first thought was that the colors are represented as standing in similarity relations, which he presumably takes to explain why we make various color similarity judgements, why we sort apparently colored objects in certain ways, and so forth. Applying Jackson's first thought to the present example, if the subject's experience does *not* represent the proposition S, there is no reason to expect her to behave in the appropriate way.

So, given our simplification of the appropriate behavior, the suggestion is this. Necessarily, the proposition S is true if any suitably cooperative (etc.) subject who sees that three chips are orange, red, and green, and whose visual experience represents S, will put the orange chip closer to the red one than to the green one.

How could the sufficient condition for S's truth *fail* to hold?[28] You are a subject eager to please the experimenter; you see that three chips are orange, red, and green; because your visual experience represents S, the first one strikes you as more similar to the second than to the third; no obstacles prevent you from putting the orange chip closer to the red one than to the green one. So that's what you'll do. If Jackson's suggestion—as we have reconstructed it—is correct, the behavioral sufficient condition for S is

guaranteed to obtain, and therefore S is a necessary truth. And this is a welcome result. Surely it didn't just *happen* to be true that orange is more similar to red than to green—it *had* to be that way.

To summarize. Jackson proposes that the similarity phenomena (in the chosen example of orange, red, and green) are to be explained by the visual representation of a certain proposition S. S is the proposition that orange is more similar (in respect X) to red than it is to green, but Jackson does not tell us how we should fill in the letter 'X'. He instead suggests that S has a behavioral sufficient condition, and (according to our reconstruction) this has the consequence that S is *true,* moreover *necessarily* true. Grant that all this is right—has Jackson successfully defended physicalism against the argument from similarity?

No. The problem should now be plain. Jackson must show that the proposition S is not in conflict with any announcement from color science, assuming that colors are physical properties. But all that has been shown, at best, is that S—whatever it may be—is *necessarily true.* And of course this result does nothing to show that the conjunction of color science and physicalism is consistent with S. In fact, it actually bolsters the case *against* physicalism, by foreclosing a possible reply to the argument from similarity. The physicalist might have hoped to bite the bullet in the worst-case scenario where the physical properties turn out to stand in the wrong relations, and deny that S is true. But on Jackson's account, this is not an option: S is (necessarily) true, and so if there is any conflict, physicalism is the guilty party.

Here's another way of looking at it: Jackson's opponent, who thinks that S is the proposition that orange is more *genuinely* similar to red than to green, is not prevented

from also holding (and almost certainly will hold) that S is a necessary truth.[29] Further, nothing prevents her from agreeing that, necessarily, a suitable subject in such-and-such conditions would engage in suitable behavior—in other words, that Jackson's behavioral sufficient condition obtains. Consequently nothing prevents her from *agreeing with Jackson*.

6 Are similarity phenomena explained by the representation of similarity?

Return to Jackson's first thought: the similarity phenomena are explained by the representation of similarity relations (genuine or otherwise) between properties.

Consider our (incompletely specified) proposition S again: orange is more similar to red than to green (for the purposes of this section it won't matter what the "respect X" is, so we can leave it implicit). Is S represented by any visual experience, or just visual experiences as of orange, red, and green objects? Clearly not the former. The content of visual experience is supposed to capture *the way the world visually appears to the subject*. And when a subject is, say, enjoying a visual experience as of purple and turquoise objects, it is not at all plausible that the property orange appears to her to be more similar to red than to green. And likewise when her visual experience is as of orange and red objects: maybe orange and red appear to her to be similar, but *green* does not enter into the content of her experience at all.

This makes trouble for the claim that S is visually represented. Imagine someone who *successively* has standard visual experiences of a peach, a raspberry, and a lime. On the basis of these experiences, she will judge that orange is more similar to red than to green. But there is never any time at which her experience represents S. Therefore whatever explains her similarity judgement, it is not the visual representation of S.

Further, once we have the explanation of the subject's similarity judgement to hand, we can presumably use it to explain similarity judgements made on the basis of simultaneously presented objects, and similarity phenomena in general. So there is no need to suppose that S is visually represented at all.[30]

And if S isn't visually represented, this avoids a certain embarrassment that has so far been studiously ignored. If S *is* visually represented, then the colors—that is, certain *properties*—are among the *objects* of perception: in particular, *the property orange* visually appears, or looks, more similar to the property red than it does to the property green. Thus, in addition to seeing particulars like persimmons, patches of orange paint, glasses of Sunkist, match-strikings, and orange lights, we also see the property orange itself. (Nominalists, then, failed to pay attention to the evidence of their own eyes.) Now, if something is an object of perception, it must look a certain way: persimmons, patches of orange paint, glasses of Sunkist, match-strikings, and orange lights all look *orange*. But how does *the property orange* look? Not orange, or any other color! In fact, the only immediately available answer is that it looks more similar to red than to green, more similar to yellow than to purple, and so on. But surely if the colors are among the objects of perception, it is possible to see just *one* color: for example, when one looks at a persimmon, presumably one only sees the property orange (more exactly, a particular shade of orange). On *this* occasion, how does the property orange look? Here there seems to be no obvious answer at all.[31] And even if we suppose that the property orange *does* look F (for some filling for 'F'), the question arises of whether we see Fness, and if so, how it looks. If we do see Fness, and it looks G, then the question arises of whether we

see Gness, and this regress had better stop somewhere. The most natural place to stop it is at the very start. Persimmons are among the objects of vision; the property orange is not.

There is excellent reason, then, to suppose that S is not visually represented. *Orange* doesn't look more similar to red than to green. Rather, the correct description is this: any *object that looks orange* looks more similar (in respect of color) to any object that looks red than it does to any object that looks green. One might sum this up by saying that orange looks more similar to red than to green, but this form of expression should not be taken too seriously. True, we do say we see the color of the tomato, the blue of the ocean, and so forth, but this is entirely superficial evidence for the dubious claim that among the objects of vision are not only fruits and bodies of water, but also the colors.

If the preceding is correct, the argument from similarity collapses. It depends on the premise that ordinary visual experience gives us good reason to believe genuine similarity claims about *the colors*. And it is hard to see how ordinary visual experience could do that, unless it represents propositions like S.

Granted that colors are not among the objects of perception, it might be thought the argument from similarity can be revived by simply replacing the crucial claim about genuine similarity relations between the color *properties* with one about genuine similarity relations holding between colored *particulars*. Visual experience, although not representing that the *colors* are genuinely similar, does represent that colored *objects* (i.e. opaque objects, transparent volumes, and light sources) stand in genuine similarity relations. A visual experience as of an orange object, a red one, and a green one represents, inter alia, that the first object is more similar in the *genuine* respect of color to

the second than to the third.[32] As before, if colors are physical properties this holds out a hostage to the deliverances of color science: perhaps color will turn out not to be a genuine respect of similarity after all.

However, the visual representation of the similarities between *objects* does no work in explaining the similarity phenomena, for essentially the same reason that scotched the earlier suggestion about the visual representation of the similarities between *properties*. We can see this by returning to our subject who *successively* has standard visual experiences of a peach, a raspberry, and a lime. On the basis of these experiences, she will judge that the peach is more similar (in respect of color) to the raspberry than to the lime. But there is never any time at which her experience represents the proposition that the peach is more similar (in respect of color) to the raspberry than to the lime. Therefore whatever explains her similarity judgement, it is not the visual representation of this proposition. So there is no need to suppose that such propositions are visually represented.

The lesson is that the representation of similarity doesn't explain the similarity phenomena. But now we have a problem: what *does* explain them? A hardline behaviorist has a ready answer, which is no doubt why Quine is perfectly happy to appeal to the child's "prelinguistic quality space" (1960, p. 83). Behaviorism aside, though, it is all rather perplexing. The peach and the raspberry, one might think, don't seem to *share* a color property. So how come they *look similar*?[33]

7 Similarity phenomena and hue magnitudes

Although the argument from similarity has turned out not to amount to much, we are still in a bit of a fix. On the one hand, we don't want to say that visual experience represents

color properties as having properties, or standing in relations. On the other hand, we want to respect the idea that if an attentive and competent subject undergoes a standard visual experience of a tangerine, a strawberry and a cucumber, and takes her experience to be veridical, then she will find it compelling that the tangerine is more similar (in respect of color) to the strawberry than it is to the cucumber. So far, we have seen that Jackson's suggestion satisfies the second desideratum but not the first. I shall now give an account of the visual representation of colors that seems to me to satisfy both.

It is a natural thing to say, and people *do* say, that when traversing the hue circle from blue through purple towards red, the colored samples become "less blue" and "more red", until all "traces of blue" are extinguished, and then the samples become "less red" and "more yellow", and so on, through green returning back to blue. What's more, if subjects are asked to estimate the "relative amounts of hues" in a stimulus (e.g. 30% red, 70% blue), not only do they seem to understand the instruction, but they give similar answers.[34] Observations like these are the foundation of the opponent-process theory of color vision.[35]

On the face of it, though, none of this makes much sense. Blue, for example, is surely a *property*, and an object doesn't have an *amount* or *proportion* of a property—it either has the property or it doesn't. There is a way out, though. Although blue *is* a property, when an object looks blue the content of the experience has a certain complexity: specifically, the object is represented as having proportions of two "magnitudes". One of these magnitudes is the "bluish" magnitude—the magnitude any bluish-looking object is represented as having—and the other will either be the reddish magnitude (if the object looks to be reddish blue) or else the greenish magnitude (if the

object looks to be greenish blue). I shall argue that this proposal gives the right account of similarity phenomena. But first a good deal more explanation is needed.[36]

For our purposes, a *magnitude* **M** is a set of properties *M*, the members of which are the *values* of **M**, together with a *ratio scale* $S_{\mathbf{M}}$. The ratio scale $S_{\mathbf{M}}$ is simply an equivalence class of functions from the members of *M* to the real numbers, with the equivalence relation holding between functions *f* and *g* ($f \approx g$) iff there is a positive real number *n* such that for all *x*, $f(x)=ng(x)$. One might identify various magnitudes in the intuitive sense, like length, speed and mass, with magnitudes in this formal sense, just as one might identify properties with functions from possible worlds to sets of individuals. For example, the magnitude *length* in the intuitive sense might be identified with the magnitude **L**, which comprises the set *L* of all particular length properties (being two inches long, being six inches long, being three miles long, …) plus a ratio scale $S_{\mathbf{L}}$ that includes the function that takes a length property *l* to the number that specifies *l* in metres, and so also includes the function that takes *l* to the number specifying *l* in feet. Alternatively, the formal magnitudes might be taken to be useful proxies for the intuitive ones, just as one might say that functions from worlds to sets of individuals, while not *being* properties, can nonetheless go proxy for them for certain purposes. Here, we do not need to choose.[37]

The values of a magnitude **M** are just properties, and so an individual *a* can be represented as having a particular value of **M**. Thus, '*a* is one metre long' is true iff *a* has a particular value *l* of **L**. Imagine that the predicate 'is F' has its reference fixed to be the length property had by a certain stick (cf. Kripke 1980, pp. 55-6). In fact, the stick is one metre long. So '*a* is F' is true iff *a* is one metre long. There seems to be an important

difference, though, between '*a* is one metre long' and '*a* is F'. The former encodes information about the scale of **L**, while the latter doesn't. Consider another predicate, 'is G', introduced in the same way as 'is F', with the reference-fixing stick now being two metres long. Necessarily, if *a* is F and *b* is G, then *b* is longer than *a*. Intuitively, however, this *modal* implication does not have a parallel *a priori* implication. It does not follow a priori from the proposition that *a* is F and *b* is G, that *b* is longer than *a*. But this *does* follow from the proposition that *a* is one metre long and *b* is two metres long. The magnitude **L** can be completely specified given all predicates of the form 'is *x* metres long': $L = \{X : X = \lambda y(y \text{ is } x \text{ metres long}), \text{ for all } x\}$, $S_{\mathbf{L}} = \{X : X \approx$ the function that takes the property of being *x* metres long to the number *x*, for all *x*$\}$. However, only *L* and not $S_{\mathbf{L}}$ can be completely specified given all predicates like 'is F' and 'is G': $L = \{\lambda x(x \text{ is F}), \lambda x(x \text{ is G}), \ldots\}$. We can mark this difference by saying that sentences like '*a* is one metre long' represent an object *as having a value of a magnitude*, whereas sentences like '*a* is F' do not.

Suppose now we have two magnitudes, say "height" **H** and "width" **W**. Think of the values of **H** and **W** as properties had by suitably oriented rectangles, and call the sum of a rectangle's width and height (picking some units of measurement) its *size*. The sentence '*a*'s height is 25% of its size' does more than simply attribute a certain property to the rectangle *a*, just as '*b* is one metre long' does more than attribute a certain property to *b*. From the proposition that a's height is 25% of its size and that *b*'s height is 20% of its size it follows a priori that *b* is a "skinnier" rectangle than *a*. We can mark this fact by saying that sentences like '*a*'s height is 25% of its size' represent an object *as having proportions of the magnitudes **H** and **W***.

With the usual allowances made for shoehorning the content of experience into linguistic form, the current proposal is that objects are represented *as having proportions of "hue" magnitudes*, just as, in the example of sentences like '*a*'s height is 25% of its size', the rectangle *a* is represented as having certain proportions of the magnitudes **H** and **W**. We need four hue-magnitudes, **R**, **Y**, **G**, and **B**. Set aside for the moment the question of just what these magnitudes are. An object will possess certain values of these magnitudes; call their sum (picking some units of measurement) the object's *total hue* (analogous to a rectangle's *size* in the previous example). The idea is that if an object is perceived as orange, then it is represented as having a value of **R** that is approximately 50% of its total hue, and similar with **Y**: say, a 60% proportion of **R** and a 40% proportion of **Y**. If an object is perceived as purple, it is seen as having **R** and **B** in a similar proportion, say a 55% proportion of **R** and 45% proportion of **B**. If an object appears blue, it is seen as having a high proportion of **B** and a relatively low proportion of either **R** or **G**, and so on

Now this simple sketch needs a number of elaborations and qualifications. Before noting some of these, let us see how similarity phenomena might be explained. Imagine three chips, *a*, *b*, and *c*, painted a slightly reddish blue, a slightly greenish blue, and orange. *a* is represented as having a 10% proportion of **R** and a 90% of **B**; *b* is represented as having a 20% proportion of **G** and an 80% proportion of **B**; and *c* is represented as having a 45% proportion of **R** and a 55% proportion of **Y**. The proportion of **B** that *a* and *b* appear to have is therefore approximately the same, while the proportion of **R** that *a* appears to have is quite different from the proportion that *c* appears to have. There is nothing *else* available to the subject that is relevant to her

similarity judgement. Therefore—or so I claim—it is perfectly intelligible why any attentive and cooperative subject, reflecting on the way the three chips appeared to her, would assert that *a* is more similar (in respect of color) to *b* than to *c*. Of course, there *is* a respect in which *a* appears more similar to *c* than to *b*, namely that both *a* and *c*, but not *b*, appear to have *some* (non-zero) proportion of **R**. But absent some special context it would be slightly perverse, although not unintelligible, for a subject to take that respect to be more important or salient than the fact that *a* and *b* both appear to have about the same proportion of **B**.

It must be emphasized that objects are *not* supposed to be seen as having *particular* values of hue magnitudes. Undergoing a color experience is thus analogous to being told that the height of a rectangle is 25% of its size—this is not information that the rectangle has a *particular* height.

As a bonus, the magnitude account gives us an obvious reply to Hardin's argument from binary structure, mentioned in section 1. Orange is a binary hue because any object that looks orange is represented as having a (non-zero) proportion of both the **R** and **Y** magnitudes. That is the sense in which "orange is a perceptual mixture of red and yellow". Green is a unique hue because it is possible for an object to be represented as having a value of **G** that is 100% of its total hue.[38]

Now to various qualifications. Obviously this is an extremely simple model of color similarity. Only the hues are treated, not saturation or lightness. And in any case there may well be too much precision. Perhaps no colored chip visually appears as having *exactly* a 30% proportion of **B** (say), even under ideal viewing conditions. Further, it might be claimed that the hues do not have the assumed phenomenal structure of being

perceptual mixtures of red, yellow, green and blue: for instance, perhaps certain shades of brown are not perceptual mixtures at all.[39] And nothing has been said about the interaction between the visual representation of colors and other visually represented properties, for instance shape. However, elaborating the view to accomodate points like these does not seem to present any intractable difficulty.[40]

Finally, what *are* the magnitudes **R**, **G**, **Y** and **B**? For our purposes, the question can be left unanswered—beyond noting that for all color experience has to say on the matter, they *could* be physical magnitudes. We just require that visual experiences represent objects as having certain proportions of these magnitudes, and that imposes no substantive constraint on what they might turn out to be.

8 Coda: natural properties and Kripke's Wittgenstein

We started with the intuitive thought that visual experience informs us that the *colors* are similar in a genuine respect. That turned out to be a bit of misdirection: it is better to express the thought by saying that visual experience informs us that *objects* are similar in the genuine respect of color. And if the account just given is correct, this thought is wrong. We can explain why tomatoes look more similar (in respect of color) to lemons than to Brussels sprouts, why raspberries look more similar (in respect of color) to strawberries than to blueberries, and so forth, without assuming that visual experience informs us that similarity in respect of color is a genuine respect of similarity. So, although we might be inclined to say that the colors are *natural properties* in Lewis's sense (1983), or at least that the property red is *more natural* than the property red-or-green (for Lewis, naturalness comes in degrees), that inclination—at least to the extent that it is based on visual experience—is misguided.

If the account works for color, then something along similar lines might be expected to work for other families of properties that make for salient perceptual similarities, for example shapes, tastes, and sounds. Suppose this is right. Then ordinary experience gives us little or no reason to believe that properties like colors, shapes, sounds, and so forth, are natural properties, or are natural to a high degree.[41]

This is relevant to the problem of the metaphysical underdetermination of the content of thought and talk, discussed by Wittgenstein as channelled by Kripke (1982; see also Putnam 1977). In a nutshell, the worry is that no contribution from either us or the world makes it the case that 'green' refers to the property green as opposed to infinitely many gerrymandered alternatives that on philosophical reflection appear to be equally good candidates.

The solution, according to Lewis (1983) and Walker (1989, ch. 8), is that the required contribution comes partly from the world: it contains *natural* properties. 'Green' refers to green because, of the properties otherwise eligible to be the referent of 'green', green is the most natural. Whatever might be said for this solution, it loses a great deal of its motivation unless there is an independent reason for thinking it is at least *extensionally* correct; that is, that our thought and talk does, by and large, carve the world at its joints. Why think it is extensionally correct? The main reason seems to come from perception. Objects before the eyes (or, come to that, the ears or nose) intuitively strike us as being similar in genuine respects, and those respects are the way we classify the world in thought and talk. If, as I have suggested, our tendency to read genuine similarities into the world on the basis of perception is a cognitive illusion, then we must look elsewhere for an answer to Kripke's Wittgenstein.

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[2] Goodman 1970, pp. 443-4.

[3] See especially Armstrong 1978, chs. 21, 22.

[4] See, for example, Smart 1975; Armstrong 1968, ch. 12; Hilbert 1987; Matthen 1988; Byrne and Hilbert 1997b; Lewis 1997; Jackson 1998, ch. 4; Tye 2000, ch. 7.

[5] The argument from similarity assumes that if physicalism about color is true, then any genuine respects of similarity between the colors will be evident at the level of the canonical physical description of those properties. Absent this assumption, the failure of color science to find the appropriate genuine respects of similarity would not show that such respects did not exist, thus blocking the argument. So the physicalist might reply by denying the assumption. He might say that, although colors are physical properties, some genuine respects of similarity between them can only be detected by vision. Put another way, although the colors do not stand in the intuitive genuine similarity relations *qua* physical properties, they do stand in these relations *qua* visible properties. Thus, according to this reply, there is a sense in which the nature of certain physical properties is not wholly physical, and so the view is more a kind of dual aspect theory than full-blooded physicalism. For this reason, I shall not explore this reply further. (Thanks here to Steve Yablo and Jim Pryor.)

[6] Johnston's argument, in particular, is considerably more sophisticated than the one in the text, but for reasons that will be apparent in section 3, this won't matter.

[7] The sense in which purple is a perceptual mixture of red and blue should not be confused with claims about mixing red and blue pigments or lights. For example, the typical result of mixing blue and yellow pigment is green pigment, but green is not a binary color: there is a shade of green that is neither bluish nor yellowish.

[8] See also Varela et al. 1991, pp. 165-6; Thompson et al. 1992, p. 16; Thompson 1995, pp. 123-4.

[9] On these issues, in particular non-conceptual content, see Evans 1982; Peacocke 1992; Crane 1992; McDowell 1994; Bermúdez 1998; Stalnaker 1997.

[10] I have to give a *partial* answer to the first question: whatever propositions are, necessarily equivalent propositions may be distinct (see section 7). So I must assume that propositions are not sets of possible worlds.

[11] Peacocke holds a variant of this position (1992).

[12] "[T]eal and turquoise exhibit a kind of similarity that is not a similarity in the other properties to which they are related, nor a mere similarity in their causes and effects, nor a similarity in the properties upon which they supervene. Rather the similarity between teal and turquoise with which we are concerned is to be found in any possible situation no matter how their instances, effects or contingent relations with other properties (including lawlike relations) vary. This is what I mean to focus upon by saying that teal and

turquoise are essentially and intrinsically similar. Suppose one could spell out the nature of teal and the nature of turquoise, i.e., the higher-order feature that these properties have in any possible situation. Then that specification of features would list some common features of teal and turquoise. That is the way in which teal and turquoise are similar. They are not similar simply in virtue of being (even nomically) related to similar consequences or similar bases. They are similar in virtue of what they essentially and intrinsically are." (1992, p. 152)

[13] Although this is surely the commonsense view of the matter, I must admit that among philosophers Johnston is hardly alone in denying it.

[14] This is qualified in section 6, where I argue that our opinions about the similarities between color *properties* derive wholly from our opinions about the similarities between colored *objects*. Until section 6, I shall continue to speak (misleadingly, by my lights) of similarities between color properties without any qualifications.

[15] As Steve Yablo pointed out to me, a similar difficulty afflicts Boghossian and Velleman (1989; 1991). According to them, "colors are qualitative properties of visual experiences that are mistakenly projected onto material objects" (1991, p. 131). One of the advantages of this view, they think, is that it accomodates our knowledge of genuine similarity claims about the colors solely on the basis of ordinary visual experience.

[16] See also Hacker 1987, Stroud 2000, and—for a position at least sympathetic to primitivism—Broackes 1992.

McGinn used to be a dispositionalist (1983), and his current view retains, as he says, the spirit of dispositionalism. He holds that although colors are not *identical* to dispositions to look colored, they are necessarily coextensive with them.

Johnston's most recent view, I should add, is a version of primitivism (1998; see also his in-progress manuscript *The Manifest*).

[17] Quoted by Johnston (1992, p. 138). Johnston uses this passage to illustrate the doctrine he calls *Revelation*, that the "intrinsic nature" of the colors is "fully revealed" by ordinary visual experience (p. 138).

Incidentally, according to Russell's official explanation of 'sense-datum' in *The Problems of Philosophy* (1912, p. 4) *colors* are examples of sense-data, and so sense-data are properties. But he later adopts the more common usage on which sense-data are particulars (p. 58).

[18] See Yablo 1995, pp. 486-7.

[19] In support of this conclusion, see many of the papers collected in Kim 1993.

[20] On one view, properties are not divided into the dispositions and non-dispositions *simpliciter*, but are merely referred to by dispositional and non-dispositional *expressions* (in an approximately equivalent idiom, the dispositional/non-dispositional distinction is at the level of sense, not reference). It would thus be perfectly possible for the disposition "to manifest the appearance Tq" to be identical with a (perhaps highly disjunctive) physical property of some kind. On another view, even though some properties are dispositions *simpliciter*, and not just dispositions relative to a way of picking them out, "two" apparently very different dispositions may turn out to be identical. In particular, the *psychological* disposition "to manifest the appearance Tq" might be identical to a *physical* disposition—perhaps the disposition to reflect light in such-and-such ways, or

the disposition to produce brain state TQ. If either of these two views is correct, colors might be physical properties even if dispositionalism is true. Now the argument from similarity, as I have presented it, purports to draw unacceptable consequences merely from the premise that colors, whatever *else* they are, are physical properties. Therefore the argument from similarity threatens the above two versions of dispositionalism, on which colors might turn out to be physical properties of some kind. (Johnston's brand of dispositionalism is evidently neither of these.)

It may be replied that all the dispositionalist needs is *a* genuine respect in which teal and turquoise are similar, and this is provided by Johnston's principle that two dispositions are "essentially and intrinsically similar if [their] two manifestations are similar". According to this reply, even though teal and turquoise might be physical properties that are quite unalike in "higher-order microphysical respects", they are similar in *another* genuine respect: their "two manifestations are similar".

This is not convincing, however. Suppose, first, that the view that properties are dispositions only relative-to-a-description is right. Then Johnston's principle doesn't have much plausibility at all. On this view, it is not in the *nature* of teal that it is a disposition to manifest Te; rather, all that's true is that 'the disposition to manifest Te' refers to teal.

Suppose, on the other hand, that the second view is right, and that the dispositions to manifest Te and Tq are identical to, respectively, the disposition to produce neural entity TE and the disposition to produce neural entity TQ. We may suppose that TE and TQ are quite dissimilar. And if—as we may further suppose—TE = Te and TQ = Tq, then even given Johnston's principle we do not get the desired answer, that the dispositions are genuinely similar.

[21] Johnston gives such a strengthened version of the argument, although Boghossian and Velleman do not.

[22] Here we need the assumption in note 5 above.

[23] On the former see, for example, Hurvich 1981, ch. 4; on the latter see Nassau 1980. Hilbert once suggested that the desired color similarities can be recovered from certain genuine similarities among triples of integrated reflectances (1987, pp. 115-8), but later conceded that this particular proposal would not work (Byrne and Hilbert 1997b, p. 285, n. 32).

[24] As Lewis notes, there can be an experience of reddish green under special conditions, according to Crane and Piantanida 1983.

[25] Note that this reply to the argument from similarity is more concessive than Johnston's. The physicalist version admits that the colors do *not* stand in the appropriate genuine similiarity relations. However, Johnston claims that the colors *do* so stand, on the ground that two dispositions are "essentially and intrinsically similar if [their] two manifestations are similar" (see the quotation at the start of section 2).

[26] Johnston offers a related suggestion on behalf of those (not including Johnston) who "think of visual experience as the entertaining of contents concerning the scene before the eyes": "there is a level of content concerning what…colors are like, what their natures are. This could be understood as the attribution of higher-order properties to the color…properties themselves" (1997, p. 173).

[27] In fact, there is such a mismatch. The Munsell color-order system positions the hues in roughly equal jnd-steps, and the greens and the purples are equally close to the blues. But blue is *more* similar to purple than to green. More fundamentally, the relation between similarity and jnds is an empirical matter, not to be settled by a priori philosophical analysis (cf. Clark 1993, pp. 81-4).

[28] On the view that colors are properties of sense-data, mistakenly taken by ourselves to be properties of objects like tomatoes, perhaps it is *impossible* for external objects to be colored (how *could* such properties be properties of external objects?). And if it *is* impossible, then a fortiori it is impossible to *see* that an object has a color, and so the sufficient condition for S's truth will not hold, because there can't be such a suitable subject. But this is a rather extreme view, and certainly Jackson does not take it seriously (although he did hold something similar in Jackson 1977). So let's assume that we always can find a suitable subject in some possible world, if not in our own.

[29] Cf. the quotation from Johnston in note 12 above.

[30] Since highly determinate shades that are close together on the hue circle can only be discriminated in a simultaneous presentation, it is important to run this argument with determinables like red and orange rather than shades. Different sorts of contrast effect slightly complicate the comparison of the simultaneous and successive cases, but we can harmlessly ignore this complication here.

[31] Admittedly, we might say that this *shade of orange* looks saturated, reddish, or dark, but this seems to be nothing more than a misleading way of talking about how *patches* or *regions* of this shade look.

[32] Note that 'represents that' must be read as including 'the genuine respect' within its scope. The proposal under discussion is not that visual experience just represents that objects are similar in respect of color, which is in fact a genuine respect of similarity.

[33] According to Byrne and Hilbert (1997b), the similarity phenomena have their source, not in the representation of *similarity*, but in the representation of *common properties*. Thus, in the case of the peach, raspberry, and lime there must be a color property that the first two, but not the third, are represented as having. Byrne and Hilbert try to give this rather surprising assumption some independent motivation (p. 278).

On Byrne and Hilbert's account, the similarity phenomena are to be explained by the comparative *numbers* of common properties represented. In general, if *x* looks more similar (in respect of color) to *y* than to *z*, then according to Byrne and Hilbert, this is because there are more color properties that *x* and *y* are both represented as having than there are color properties that *x* and *z* are both represented as having.

And this is unsatisfactory. What is doing the work in explaining similarity phenomena is not simply *the way that objects look*, but the *further facts* that the subject (a) somehow registers the comparative numbers of color properties and (b) makes her similarity judgements on this basis. And both (a) and (b) *are* further facts. On Byrne and Hilbert's account, a tangerine, a beetroot, and a fava bean might look to an attentive subject exactly the way they standardly look, and yet the subject might have no tendency to think that the tangerine is more similar in respect of color to the beetroot than to the fava bean because her subconscious property counter wasn't working. What's worse, she might judge that the tangerine was more similar to the fava bean than to the beetroot

because her property counter was malfunctioning. And even if the subject *did* register the comparative number of properties, why would she find it at all *compelling* that the beetroot is more similar to the tangerine than to the fava bean? One *might* make similarity judgements on this basis, but then again, one might not.

[34] See, for example, Werner and Wooten 1979. The Natural Color System (NCS) is derived from subjects' judgements about the proportion of the four unique hues in a stimulus (see Sivik 1997).

[35] According to opponent-process theory, hue is coded by two neural opponent "channels": the r-g (red-green) channel and the y-b (yellow-blue) channel. The redder (yellower) the stimulus appears, the more positive the r-g (y-b) channel; the greener (bluer) the stimulus appears, the more negative the r-g (y-b) channel. For more details see, for example, Hardin 1993, ch. 2.

[36] Levinson (1978) observes that 'being red' cannot be substituted for 'red' (the noun) while preserving grammaticality (cf. 'Red is the color of my automobile' and the ungrammatical 'Being red is the color of my automobile'). He takes this to indicate an ontological distinction between *properties* (e.g. being red) and *qualities* (e.g. red, redness). The latter but not the former are supposed to come in degrees (cf. 'There is some/a small amount of/much red in his tie'). Whether or not Levinson is right about the ontology, his insight that we sometimes think of colors as akin to stuffs, like gold and gravy, certainly needs explaining. It might be that the account of the content of color experience outlined in this section provides part of the explanation, although I shall not examine this further here.

[37] Note that temperature is not happily thought of as a magnitude on the above account because the usual temperature scale (i.e. that equivalence class whose members include the Centigrade function that takes the temperature property of boiling water to the number 100, and the Fahrenheit function that takes this property to the number 212) is an interval scale, not a ratio scale (there is no privileged zero point). This problem could easily be fixed by broadening the definition, but there is no need to do it here.

[38] Tye's preferred response to Hardin is not to appeal to the content of visual experience, but to accept the challenge he takes Hardin to be making: the physicalist can maintain "that orange is a literal, nonperceptual mixture of red and yellow" (2000, p. 163). Although Tye's response is bound up with a particular kind of physicalism, it seems that it doesn't depend at all on the details, and may be put abstractly as follows. The property orange is the property of being both reddish and yellowish (cf. Byrne and Hilbert 1997b, p. 280). So, if reddishness is identified with physical property R, and yellowishness is identified with physical property Y, then the property orange is the property of having R and Y, and is thus a "mixture" of R and Y. (See pp. 163-4.) This certainly seems to be Tye's response, but if it is then the above quotation is not quite accurate. Orange turns out to be the *conjunction*—surely not a "literal mixture"—of, not red and yellow, but reddishness and yellowishness (the properties are different: an aubergine is reddish, but not red). Setting aside Tye's apparent failure to supply exactly what he takes Hardin to be demanding, the main problem is that green turns out (incorrectly) to be a "mixture" in exactly the same sense that orange is a "mixture": for example, green is a "mixture" of the properties *green or not-red* and *green or red*.

Tye briefly suggests another way of replying to Hardin, which does involve the content of experience: “Orange is a perceptual mix of red and yellow [because]…[i]n experientially representing something as orange, we represent it as being red to a degree and also as yellow to a degree” (pp. 164-5). This is somewhat similar to the proposal made in the text.

[39] On brown, see Quinn et al. 1988. For an expression of radical skepticism about the generally accepted view of color phenomenology, see van Brakel 1993.

[40] The present proposal does have explanatory limits, though. It is sometimes claimed that *unique* green is intuitively more similar to *unique* blue than it is to *unique* red, and if this is right, the magnitude account cannot provide an explanation.

[41] This conclusion is not just motivated by my account. Jackson, and Byrne and Hilbert (see note 33 above), could argue in a similar style.

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