Philos Stud (2009) 142:353–369
DOI 10.1007/s11098-007-9191-z

The event of color

Robert Pasnau

Published online: 14 December 2007

Abstract When objects are illuminated, the light they reflect does not simply bounce off their surface. Rather, that light is entirely reabsorbed and then reemitted, as the result of a complex microphysical event near the surface of the object. If we are to be physicalists regarding color, then we should analyze colors in terms of that event, just as we analyze heat in terms of molecular motion, and sound in terms of vibrations. On this account, colors are not standing properties of objects, but events, or (more cautiously) properties associated with events. Accordingly, objects in the dark are no more colored than a turned-off stove is hot. Such an account requires rejecting some of what folk ordinarily say about color, but this is the most coherent version of color physicalism.

Keywords Color

Frank Jackson maintains that the theory of color is one of those areas where "we know the live possibilities." Here they are:

> The colours must, if they are instantiated anywhere, be findable somehow, somewhere in accounts that mention dispositions to look coloured and affect light, the physical bases of these dispositions, and colour experiences (1998, p. 87).

Jackson has left something out. Indeed, so far as I can find, everyone working on the philosophy of color has ignored what is in many ways the most promising candidate for color: the event that takes place at the surface of an object illuminated by light. When objects are illuminated, the light they reflect does not simply bounce off their surface. Rather, that light is entirely reabsorbed and then reemitted, as the result of a

R. Pasnau (✉)
Department of Philosophy, University of Colorado, 232 UCB, Boulder, CO 80309, USA
e-mail: pasnau@colorado.edu

complex microphysical event near the surface of the object. If we are to be physicalists regarding color, then we should analyze colors in terms of that event, just as we analyze heat in terms of molecular motion, and sound in terms of vibrations. On this account, colors are not standing properties of objects, but events, or (more cautiously) properties associated with events. Accordingly, objects in the dark are no more colored than a turned-off stove is hot. Such an account requires rejecting some of what folk ordinarily say about color, but this is the most coherent version of color physicalism.

In the first section, I say enough about color science to make clear the difference between my account and standard accounts of color physicalism. Then, in the next three sections, I offer a series of arguments for my own proposal. Finally, in the last three sections, I consider the difficulties facing my account, and the implications of this account for the larger debate between physicalism and its rivals.

1 Color events

Physicalists treat color as a feature of an object in virtue of which it reflects certain wavelengths of light while absorbing other wavelengths. Although there are many versions of physicalism, they tend to agree on this basic point: that a particular instance of a color, on the surface of an object, is the enduring microphysical structure that explains why the surface has its distinctive light-reflecting characteristics.[1] What physicalists have ignored, however, is that we can distinguish between those standing properties and the events and properties that arise when an object is illuminated. It is easy to ignore this distinction if one thinks of light as simply bouncing off of surfaces, like waves bouncing back from the edge of a pool. This, however, is never what happens. When light reflects from the surface of an object, a complex event occurs on that surface. Although different kinds of material absorb and reflect light in virtue of very different microphysical processes, the common element in almost every case is the way the energy of light reconfigures the orbital distributions of electrons. Certain distributions are receptive to receiving certain amounts of energy. When a colored surface is illuminated, some of the energy from that light excites the surface's electrons in such a way that they absorb and then release varying percentages of that light across the visible spectrum. It is in virtue of such activity that objects have a certain color. As Hazel Rossotti puts it in her engaging and nontechnical discussion of these matters, "the characteristic colour of an object, in daylight, depends on the wavelength needed to produce a readjustment of electrons, because it is these energies which determine the composition of that remaining mixture of light which enters our eyes and causes the sensation of colour" (1983, p. 42).

The details here are complex, and made more so by the many different ways in which color is produced. What matters for present purposes, however, is just this

[1] Here I am treating physicalism as distinct from all forms of dispositionalism. Some dispositionalist views are sometimes treated as versions of physicalism (see, e.g., Byrne and Hilbert 1997 vol. 1, p. xxii), but my primary targets, for now, are those physicalists who eschew dispositionalism in any form.

general conclusion: that all color involves these sorts of microphysical events. Kurt Nassau, in his authoritative study of this subject, distinguishes fifteen broadly different ways in which colors are produced. After describing how one of the fifteen is a product of molecular motion, he remarks that

> The other 14 causes of color …, whether occurring as natural phenomena or of animal, vegetable, mineral, or of human-created origin, all involve the excitation of electrons; this includes the selective absorption and emission of light, as well as its reflection, deflection, and scattering (2001, pp. 30–31).[2]

Hence all color phenomena, whether they involve reflection, scattering, etc., involve some physical events within the colored object. This is true even in cases that might seem to involve merely a bouncing off, as in the case of a mirror. Here is how Nassau describes the behavior of a metal surface of the kind found behind the glass of a mirror:

> Since a metal effectively has a continuum of excited states, it can absorb radiation of any wavelength. A surface with this property of absorbing all colors might be expected to appear black, but metals are not an absorptive black. The reason again has to do with the agility of the metallic electrons: when an electron in a metal absorbs a photon and jumps to an excited state, it can immediately reemit a photon of the same energy and return to its original level. Because of the rapid and efficient re-radiation the surface appears reflective rather than absorbent; it has the luster characteristic of metals. If the surface is smooth enough, the reflection can be specular, as in a mirror (1997, p. 19).

Even a mirror, then, is not simply reflecting the light, without alteration, but absorbing and then emitting light. Other surfaces work similarly, just less efficiently.

My proposal, stated most broadly, is that we analyze colors not in terms of the standing physical properties of a surface, but in terms of the events and properties that arise when a surface is illuminated. I call this *event physicalism.* How exactly to spell this proposal out depends on broader metaphysical issues that are beyond the scope of this paper. Most radically, one might propose simply identifying colors with the events that are the proximate cause of an object's emitting light. One can be an event physicalist, however, and hold onto the more familiar idea that colors are properties, so long as one endorses the idea that a surface has the property of being colored when and only when an event of the appropriate kind is taking place. The first, more radical view can of course be expressed by saying that colors are (identical to) events. To speak in a way that includes the second, more cautious view, I will speak of colors as being *tied* to events. It would be good to reflect further on these two formulations of event physicalism, and on the ontological status of sensible qualities more generally, but I will not attempt that here.

[2] In a recent summary of this same material he remarks: "In essentially all of these 15 mechanisms it is the interaction of light with the electrons in matter that produces color" (2003, p. 248).

2 The argument from analogy

Discussions of the sensible qualities tend to treat color as a model for other qualities, and to suppose that what holds for color will hold, at least in many respects, across sensory modalities. This strategy is reasonable, at least as a starting point, since one would expect many parallels to hold among the sensible qualities, and since the case of color is by far the most studied among them, making it a natural point of departure. There are, I shall argue, good reasons for favoring a unified account (at least in some respects) of the sensible qualities (at least some of them). But I propose to turn the tables on the strategy just described, and argue that in fact we can learn something important about color by comparing it to other sensible qualities.

The argument from analogy that I will offer is by no means demonstrative, but I think that it may be dialectically effective, at least inasmuch as it prepares the ground for the stronger arguments to come. The argument, in short, will be that we conceive of other sensible qualities in terms of events—so why not color? Begin with the case of sound. A recent spate of interest in the nature of sound seems to have yielded a consensus that a sound should be understood not as compression waves in the air (or in some other media), but in terms of the event that occurs where the object makes the sound. Sounds, in short, are tied to vibrations of objects.[3] And even if sounds are understood in a more conventional way, as being in the air, they are still tied to events: that, after all, is what a compression wave would seem to be.

Advocates of this new work on sound sometimes suggest there is something distinctively interesting in sound's close connection with an event. In fact, it is far from clear that the case of sound is special. Heat is routinely identified with molecular motion, and so would seem on its face to be an event, or at least closely tied to one. Odor likewise involves motion, inasmuch as it might plausibly be tied to the release of certain particles into the air.[4] The case of the so-called primary qualities is rather different, and I will return to these in the next section. But if we focus only on the secondary qualities, the general pattern seems to be that these qualities are tied to events rather than to standing conditions. We could decide to treat sound as a standing condition, and indeed in some contexts we talk that way.

[3] The first proponents of this new theory of sound were Casati and Dokic (1994), the key claims of which can now be read in English in their (2005). In ignorance of that earlier work, theories of a similar kind were advanced in Pasnau (1999) and O'Callaghan (2007). Like Casati and Dokic, O'Callaghan puts particular weight on sound's status as an event, although he argues against a straightforward identification of sounds with vibrations (see O'Callaghan forthcoming). I am indebted to this work for provoking my own thoughts about color.

[4] In what follows I will focus on the cases of sound and heat, setting odors aside. I also set aside flavor, which admittedly seems harder to characterize in terms of an event. But flavor, like odor, seems too different from color to be very relevant here. There is every reason to think that the details in each of these cases would require independent consideration—here I simply gesture toward a rough account. Even the case of heat, though, is more complicated than philosophers generally acknowledge. There is, for instance, a distinction (strictly speaking, at least among physicists) between heat and temperature. Temperature is average kinetic energy, whereas heat is a function of kinetic and potential energy. Later I will say a bit more about whether heat should actually be identified with an event.

We speak of the warm sound of a violin even when it is in its case. We might praise a wood stove for its warmth, even when it is turned off for the summer. Yet even when it is intelligible to speak this way, we do not confuse these claims with the claim that the violin is now making a sound, or that the stove is now hot. In these dormant cases there is a disposition, and there are standing properties to ground that disposition, but the sensible quality is not there, because the right sort of event is not there—the violin is not vibrating, and the stove's molecules are in a low energy state.

The similarities between these cases and the case of color are striking. A violin possesses certain physical features that make it apt to produce a certain sound. Once the strings are struck, a sound is heard. Similarly, the leaves of an aspen possess certain features that make it suited to have a certain color, and when those leaves are struck by light, the energy of the light makes something happen on the surface of the leaves, which then results in the perception of color. Given the apparent closeness of the analogy, both to sound and to heat, it is hard to see why matters should be so different in the case of color. Why have philosophers failed to draw a distinction between the standing properties that give rise to color and the events that occur when that color is manifested? If this analogy to other sensible qualities does not actually prove that such a distinction should be drawn, it should at least make us wonder why we treat color so differently.

3 The argument from representation

An argument from analogy is effective only to the extent that one accepts that the cases under discussion should be treated similarly. Hence the natural response, at this point, is simply to deny that color should be treated analogously to sound and heat. Why, not, for instance, treat color as analogous to shape and size, which clearly are standing properties rather than events? Moreover, there is an obvious reason why one might insist that color should be treated differently from sound and heat: the cases should be treated differently because our concepts here, as reflected in language, just are different. In the case of heat, although it is possible to find a situation where we would focus on the dispositional or standing properties in virtue of which a thing becomes hot (in the appliance store, say), it is far more natural to focus on the actual state that is a thing's being hot or cold. In this case, for various reasons that are not hard to identify, we take less interest in the standing properties, and so our language reflects as much. In the case of color, in contrast, we have much less interest in distinguishing between the standing properties and the events that occur when an object is illuminated. Hence although we do not think that a violin in a closed case is making a sound, we do tend to think that it has a color. And indeed the verbs we use here make the point explicit: we speak of *making* a sound, but not *making* a color, and we speak of *having* a color but reserve *having* a sound for the exceptional case where we are focused on a thing's standing dispositions to produce a sound of a certain kind. These facts of English usage point toward conceptual differences in how we understand these different sensible qualities. Such conceptual differences, one might argue, make the argument from analogy worthless.

From a certain perspective, this sort of reply is absolutely decisive. If one thinks that philosophical questions about sensible qualities are semantic questions, aimed at doing justice to the way we talk and think about these qualities, then there is no reason to expect a unified approach to the different sensible qualities. If the linguistic data point toward different theories, across different cases, then we should embrace different theories, and not be concerned that sound and color turn out to require very distinct sorts of analyses. So understood, the debate over color becomes a debate over how we think and talk about color. If this is where the debate lies, then event physicalism is doomed to fail: it can scarcely be argued that we ordinarily think of colors in terms of events that come and go as lighting conditions change.

My proposal, then, has to be understood not as an account of how people actually talk about color, but of how people ought to talk about color, given what colors essentially are. The ground on which I take my stand is that colors are things represented in visual experience. This strikes me as conceptual bedrock, the one nonnegotiable feature of our concept. Since this is the fixed point from which so much of my case gets its leverage, it seems worth taking the time to document the extent to which philosophers working on sound, across the spectrum of views, agree in accepting this as a fundamental principle. Here, for instance, is how Edward Averill begins a recent paper in defense of projectivism:

> In this paper, seeing is assumed to be a matter of visual representation. Thus, seeing something as having a color is a matter of visually representing it as having a color. Here 'color', and the more determinate terms 'red', 'orange', 'brown', 'white', and so on, are used to refer to properties we visually attribute to things …. [A] theory [of color] is not, or at least not directly, a theory about our ordinary use of color terms (2005, p. 217).

Here too is Alex Byrne and David Hilbert, near the start of their argument for a form of dispositionalism:

> The problem of color realism concerns various especially salient properties that objects visually appear to have. It does not concern, at least in the first instance, color language or color concepts (2003, p. 4).

Here is Boghossian and Velleman, in their attack on physicalism:

> When the physicalist says that colors are microphysical properties, he must mean that microphysical properties are the ones attributed to objects by their looking colored. Otherwise, his claim will not succeed in attaching the uncontroversial reality of microphysical properties to the properties whose reality is in question—that is, the properties represented in color experience. Physicalism must therefore be, in part, a thesis about which properties color experience represents (1997, p. 108).

And here again, finally, is Jackson, who defends physicalism by appealing to what he calls "the prime intuition" about color: "The prime intuition is simply that red is the property objects look to have when they look red" (1998, p. 89). All these authors agree on what is fundamental about color even though they hold very different views about what color is.

My own use of this fundamental principle will be relatively modest: I am not attempting to argue for physicalism over dispositionalism or other alternatives, but only to show that *if* one is to be a color physicalist, one should tie colors to events. To make good on this claim, I need to show that visual perception is more plausibly understood as representing the sorts of events described in section one (or properties tied to those events), rather than as representing the standing properties that physicalists appeal to. The best way to make such a case would be to present a theory of visual representation and show that event physicalism follows from that theory. Lacking a theory of that kind, I will have to proceed more obliquely. As a first try, consider the following variation on the strategy of the previous section. As touch represents heat and hearing represents sound, so one would suppose that vision represents color. Although there are of course dramatic physical, psychological, and phenomenal differences between the various sensory modalities, one would expect the basic story about mental representation to hold constant. But, for the physicalist, it seems very plausible that touch and hearing represent events (certain kinds of motion) or else properties of those events. Touch and hearing do not represent the standing conditions that give rise to those events. It is therefore hard to see why the story would be different for color. Why would the facts about perceptual representation yield one sort of outcome in the cases of sound and heat, and quite a different outcome in the case of color?

This new argument from analogy is much stronger than that of the previous section. Whereas that argument depended on the unargued assumption that we ought to hold analogous views about various sensible qualities, here the crucial thought is that we ought to have a consistent story about perceptual representation. This thought can be reinforced, moreover, by reiterating a point made already, that the physical situation in these three cases (color, sound, heat) seems very closely analogous. In each case we begin with (a) an object in a certain microphysical state, which then, upon (b) being energized in a certain way, (c) begins to undergo some sort of change, an event that then causes (d) another event in the medium that gives rise to (e) a perceptual experience. What grounds could there be for reaching different conclusions about which stage the experience represents?

This same argument can be pushed somewhat farther by considering just how implausible it is to suppose that properties at stage (a) are what get represented in experience. This is perfectly obvious in the case of the violin. We hear the sound that the violin is making, and the physicalist asserts that this can be identified with the violin's vibrations (or something of that kind). It seems quite implausible to suppose that what gets presented to us in auditory experience are certain standing acoustic properties of the violin. Surely a grasp of such properties is inferential: we infer that the violin has a warm tone (standing property) after hearing the sounds that it makes, and judging that the sounds are a product not (only) of the musician's skills, but of the instrument's quality. The case of heat is if anything even more obvious. So why, in the case of color, would one suppose that the standing property is somehow the thing presented in experience? Is it not much more plausible to suppose that what experience presents is tied to an event on the surface of an object, occasioned by an influx of energy, and that what physicalists have hitherto regarded as the colors, the standing properties, are in fact inferred on the basis of those perceived events? No wonder Nassau, in a rare philosophical aside, finds himself able to remark that "electrons are

involved in the interactions of our 15 mechanisms and we could claim that we 'see' electrons whenever we perceive color" (2003, p. 250). What we see, in most cases, is the excitation of electrons. (To be sure, there is an air of paradox in claiming that we can see electrons at all. But this is a familiar problem for anyone who wants to identify sensible qualities with the microphysical, and there is no reason to think event physicalism raises any greater difficulties in this respect than the standard view.[5])

The argument from representation can be developed still further if one is willing to accept the natural idea that representation requires a certain sort of causal connection. This is how Jackson goes on to argue for his own version of physicalism:

> A necessary condition for *E* to be the presentation of *P* is that there be a causal connection in normal cases. Sensations of heat are the way heat, that is, molecular kinetic energy in the case of objects whose molecules move, typically presents itself to us; and essential to this is the fact that molecular kinetic energy typically causes sensations of heat in us …. For present purposes we can largely set to one side the hard question of what has to be added to causation to get presentation. We can work with the rough schema: redness is the property of objects which typically causes them to look red in the right way, where the phrase 'the right way' is simply code for whatever is needed to bring causation up to presentation … (1998, p. 90).

To my mind this is the most powerful argument in favor of physicalism. Colors are the features of objects that cause color sensations; those must be categorical, non-dispositional features of those objects. Dispositional properties are not themselves causes. But if the argument is effective against dispositionalism, it seems equally effective against standard versions of physicalism. The event on the surface of the object—the light's being absorbed and emitted by the rearrangement of electrons—seems much more plausible a candidate to be in the right causal connection to the experience. Ironically, Jackson offers his own argument from analogy here, invoking heat to show how the causal requirement works. But the case of heat, as we have seen, suggests that events are the object of perceptual awareness. And although one could insist that color just works differently, it is hard to see why we should go all the way back to the standing conditions behind an event, when the event itself (or its associated properties) seems so well positioned as a cause.[6]

[5] For a careful discussion of this problem, and various physicalist strategies for dealing with it, see Boghossian and Velleman (1997, pp. 108ff).

[6] See also Lewis (1999), both for the idea that colors are, most basically, the causes of our color experiences (p. 336), and for the worry that dispositions are the wrong sort of candidate (pp. 341–342). He himself proposes that colors (and all causal relata) should be understood as events, but not transient events of the sort proposed here. Although he doesn't consider a theory of the present sort, it is clear enough why he would reject such a view, as I will discuss below.

Jackson, in a much earlier version of his theory, co-authored with Robert Pargetter, discusses in some detail the question of whether colors are present in the dark. He and Pargetter offer a qualified yes, inasmuch as "the (physical) property which red-presents in daylight is a property that tomatoes have in the dark as well as in daylight" (p. 77). But they add that they might be wrong about this, inasmuch as "there is much about colour vision that is still a puzzle to scientists, and it just might turn out that the relevant property is only present in the daylight" (pp. 77–78). In effect, I am urging that the scientific data show that they were wrong, since what causes color vision is an event that happens only in light.

Without a theory of visual representation, and of what the right sort of causal connection is between perceiver and object, the present discussion will necessarily have something of a tentative air about it. Hence the usefulness of arguments from analogy: even without a general theory, we take ourselves to know how it works in certain cases, and can then apply those cases to other domains. But one might also hazard an attempt at a general account of what is going on. The event that is linked with color (or sound, or heat) is just one in a series of events and properties in a causal process that runs between perceiver and object. Suppose one rules out states of the perceiver or the medium as objects of perception. The question then becomes which feature of the external object to identify as the sensible quality. It seems very plausible to identify the sensible quality with that feature of an object that immediately gives rise to whatever signal passes through the medium into the perceiver. Hence sound is tied to the vibration that directly causes a compression wave in the air. Heat is tied to the motion of an object that energizes objects in its vicinity. Color is that which is immediately responsible for light's being emitted by an object. If one does not stop at the surface in this way, there will always be further causal candidates to be had. The sounds of a violin are a product of the kind of strings being used, the shape of the instrument, the character of the wood, the way the wood has been joined together, and so forth. But we don't take ourselves to *hear* those things, even if an expert may be able to make inferences. It is an old idea about perception that it gets only at the surfaces. Although that need not be literally true (in the case of sounds, for instance), it does seem to be true in this sense: that what we perceive are features of objects that are causally contiguous with the surrounding medium. This surface constraint, as we might call it, gets violated by the standard physicalist conception of sound.

By framing the argument from representation in terms of causal connections, we can see why it is more appropriate to compare color to sound and heat rather than to size or shape. As noted earlier, these latter cases pose a potential threat to my line of argument, inasmuch as they clearly are standing properties. What makes them unfit objects of comparison, we can now say, is that they are not causally related to perception in the way that sound, heat, and color are. In all three of the latter cases, as we have seen, there is an analogous story about how the sensible quality acts on the perceptual organ. Matters are very different for size and shape. We see size and shape, for instance, in virtue of seeing color, inasmuch as information about size and shape gets conveyed to sight in virtue of information about color. The very different account of how size and shape figure in perceptual experience gives us no reason to think that they would make a suitable analogy to the case of color.

4 The argument from light sources

A third kind of argument for event physicalism is that it can account both for the color of reflective surfaces and for the colors of light sources (the yellow of the sun, the red of neon lights, and so forth). The color of a light source is tied to its light-producing event, precisely as the color of a reflective surface is. In each case, if loss of energy causes the event to cease, then the object ceases to have that color.

Standard versions of physicalism almost always ignore the case of light sources, because they cannot plausibly account for them. For although it is natural to think of the colors of reflective surfaces as standing properties, present whether or not that surface is energized, we do not think of light sources that way. We do not say that a red neon light is red when it is unplugged, for instance, which is how a standing-properties account would have to have it.

Now I hope that, by now, these appeals to the linguistic data will not be *too* persuasive—after all, I eschewed arguments of this form at the start of section two, and so I have to acknowledge here that there is room for simply rejecting these linguistic intuitions in favor of a consistent account of all color as standing properties. Even so, I am not much worried about anyone's going down this path.[7] A first reason why is that unplugged lights appear to have different colors of their own. (An unplugged neon light might look white, for instance.) But then are we to say that an unplugged light has two different colors at the same time? Or that its unplugged color is not *really* its color? This seems bizarre, at first glance, but in fact it is just what standard physicalists routinely say about reflective surfaces. On their view, objects in dim light have the same color that they have in normal light, and so presumably the light they appear to have in dim light is not really their color at all. Hence it would be quite consistent to extend this idea to light sources.

Such consistency, however, comes at the expense of plausibility. For there is a second and better reason to resist extending the standard physicalist account to the case of light sources: the fact that a far more compelling story is available. If we want to describe the sense in which an unplugged neon light is red, the sorts of cases that are plainly most analogous are the sorts of dormant, merely dispositional cases considered earlier. An unplugged light seems red in just the sense that an unplugged oven seems hot, or that a violin in its case is sweet-sounding. To think that the light (when unplugged) is really red seems just as absurd as to think that the violin (in its case) is really making a sound. Of course, the standard physicalist can also be revisionary about our linguistic intuitions, but here the proposed revision seems to crudely conflate two different senses—dispositional and occurrent—in which a thing can be said to be hot, sweet-sounding, or red.

Surely what the standard physicalist ought to do, then, is to distinguish the physical state of the light when unplugged from its state when plugged in, and analyze red in terms of the latter. To do this, however, precisely is to embrace event physicalism for these sorts of cases. Color has now been tied to an object's *energized* state (event or property), a state that may be short or long lasting, and so in a sense count more or less as a standing property, but which ceases to exist when the light-producing event ceases to take place. But once we see that light sources should be understood in this way, the standard physicalist comes under pressure to describe reflective surfaces in the same way, and hence to embrace physicalism

[7] This is not to say that no one *has* gone down this path. Byrne and Hilbert attempt to deal with light sources by enlarging their form of dispositionalism so that color is a "disposition to produce (i.e., reflect or emit or transmit) a specific proportion of incident light" (2003, p. 11). This implies, as they later make explicit (p. 54), that light sources maintain their color even when turned off. Below I will suggest how their account might be modified to avoid this odd result.

across the board. The alternative is to take a disjunctive approach to color, treating light sources differently from reflective surfaces. In addition to being unsatisfying in its own right, this seems problematic for visual representation. We presumably do not want a disjunctive account of how sight represents colors, one account applying to light sources and another account applying to reflective surfaces. In each case, one would suppose, sight represents the same kinds of properties or events. Hence if we embrace event physicalism for light sources, as seems practically irresistible, we ought to embrace it for reflective surfaces as well.

Making matters still more complex, and more difficult for standard physicalism, is that there more than these two ways of being colored. There is, for instance, the interesting case of phosphorescent colors. These work much like ordinary reflected colors, except that the electrons involved maintain their excited state after the lights are turned off, and only slowly release their energy. Should these be understood on the model of the standard physicalist account, or like light sources? (Once the phosphorescence dies out, do they still have a color?) And what about colored glass or plastic, which is standardly what makes an incandescent light source appear to be colored? Does red glass always have the color that it appears to have when illuminated? (In that case, is a stop light always red, yellow, and green, all at once?) In these cases, too, there is pressure on the physicalist to produce a unified account, and event physicalism seems by far the most promising option.

Here I rest my case in favor of event physicalism, and turn toward considering two serious objections to this new and perhaps strange theory of color.

5 Color constancy

According to event physicalism, colors vary with illumination. This gives rise to an objection from color constancy, neatly formulated as follows by Byrne and Hilbert:

> [T]he color vision of human beings and many other organisms exhibits approximate *color constancy* …; for instance, tomatoes do not seem to change color when they are taken from a sunny vegetable patch into a kitchen illuminated with incandescent light. Assuming that our perceptions of color are often veridical, we therefore need a physical property of objects that is largely *illumination-independent*—a physical property that an object can retain through changes in illumination (2003, p. 9).

Byrne and Hilbert do not anticipate the present theory, but their argument clearly applies. We see colors as invariant through changes in illumination; therefore, either we have to count such invariance as illusory, or colors are illumination independent. As it stands, this argument is too brief to succeed. Although there is lively dispute over the extent to which color constancy prevails in normal vision, no one claims that it holds over all cases. So there will be some cases where objects appear the same color through changes in illumination (color constancy holds), and other cases where objects appear to change color because of a change in illumination (color constancy fails). On my proposal, vision may get it right in the second case but not in the first; on standard accounts, it is the other way around. But either account

needs to tolerate a significant degree of error.[8] Moreover, even in many cases where color constancy is said to hold, it is not clearly right to suggest that standard physicalism secures veridicality. Consider a uniformly painted object (the side of a house, say) that is partially in shadow. This is one kind of case where color constancy is said to hold: we perceive the object as having a uniform color, despite the shadow. But of course we *do* see the shadow, because we see that the surface in light looks different from the surface in shade. The event physicalist can say that those two surfaces in fact have different colors, and we correctly see as much. So even in these sorts of cases it is at best unclear which view achieves greater veridicality.

One way to supplement the above argument would be to appeal to teleological considerations.[9] Color constancy seems to have an obvious function in visual perception: we see colors as constant because it is useful to track the stable surface properties of objects, and less useful to track how those surfaces change under different illuminations. Anyone with even the slightest sympathies for a teleological account of mental representation ought to take such facts seriously in trying to understand what it is that vision represents. It represents standing colors, the claim would be, and the phenomenon of color constancy is a kind of proof that this is what the system is trying to do. To write off color constancy as an illusion would mark a perverse failure to notice what our visual system is doing when it represents color. Hence the qualities represented by vision are standing properties, not transient events.

Accounts of this form focus on the bedrock principle that color is what vision *represents*, rather than the principle in its alternate form, that color is the *cause* of vision. The latter suggests that we might understand color in terms of general principles of causality, applicable across sensory modalities. Teleological accounts, in contrast, suggest that we need to go case by case in understanding the sensory qualities, considering the distinctive features of each sensory modality, and how that modality represents the world. If this is right, then arguments from analogy like those presented earlier are of doubtful merit at best.

Even from this unfriendly vantage point, however, event physicalism can be reconciled with the argument from color constancy. For even if we were to decide that what vision represents—the colors—are constant over variation in illumination, we might still defend event physicalism, provided that we could find some constant property of the events that occur on a particular surface over varying illuminations. As it happens, there is a well developed theory of just this sort, developed by Byrne and Hilbert themselves. As Hilbert argued in the theory's original formulation, the phenomenon of color constancy is ultimately grounded in a constant feature of colored objects, their "disposition to reflect a certain percentage of the incident light at each wavelength" (1987, p. 65). The appeal to a disposition, which is what secures colors in the dark, makes this a peculiar hybrid of standard physicalism and

[8] If we follow Sorensen (2004) in thinking that we continue to see even in complete darkness, then that would be the most dramatic case where color constancy fails and where event physicalism yields veridicality: there are no colors in the dark, and we *see* that.

[9] For a recent defense of this approach to color, see Hatfield (2003).

traditional Lockean dispositionalism. If we drop the appeal to dispositions, however, then we might think of these surface spectral reflectances (SSRs) as properties of events. That is, when a colored surface is illuminated by light, an event takes place on the surface, and that event is characterized by a certain SSR. Since SSRs are defined in terms of *percentages* of reflectancy, the property holds constant over variations in illumination, so long as there is enough light of the right sort to produce a light-emitting event. (And if there is not then color constancy will fail anyway.)[10]

It is unclear to me just how much the event physicalist should concede to the argument from color constancy. But even if one wants a view on which colors are constant over a wide range of changes in illumination, event physicalism can accommodate that.

6 Heraclitus redux

Like standard versions of physicalism, the event theory is likely to be massively disjunctive in its account of what color types are. The theory has to account, first, for what we might think of as the mirror image of color constancy: the way two objects may be indistinguishable in color under a given illumination even though they reflect very different patterns of light across the visible spectrum. (This phenomenon, known as metamerism, arises because hardly any surface reflects light from just a single part of the spectrum.)[11] The theory may also (depending on what form it takes) have to account for the many different kinds of microphysical events that give rise to these reflectance patterns. (Recall that Nassau distinguishes fifteen broadly different kinds.) So far, event physicalism is no worse off than the standard theory, since the latter likewise must typically recognize a wide variety of standing properties that yield many disparate reflectance patterns. But at this point the event theory has to recognize a further dimension of heterogeneity that the standard theory avoids: it must account not only for the heterogeneity of different surfaces, but also for the heterogeneity of surface microphysical events under different lighting conditions. Versions of the theory that do not attempt to accommodate color constancy will suffer from this heterogeneity in quite a dramatic way. Aspen leaves would not only have no color in the dark, but would also constantly change color throughout the day, moment by moment, as they are successively illuminated by different qualities of light. (And if they are artificially illuminated they will have still different colors, varying along with the nature of the light source.) But even versions of the theory that accommodate color constancy (perhaps by identifying

[10] For a more recent statement of this theory, see Byrne and Hilbert (2003), published along with extensive peer commentaries and replies. My reformulation in terms of events and their properties seems an improvement in several respects on Byrne and Hilbert's own view. For one thing, it replaces their problematic appeal to dispositions with what should seems (at least to a physicalist) a more plausible candidate object of perception: features of the events that cause our visual experience. It further yields the right account of light sources, avoiding the implication that unplugged lights retain their color (see footnote 7).

[11] For details see Hilbert (1987, pp. 81–100).

colors with SSRs, in the way described above) must concede that the colors in a windowless room go in and out of existence every time the lights are turned off and on. This yields a whole new dimension of heterogeneity for the physicalist to deal with.

The precise nature of the problem will depend to some extent on some rather recondite metaphysical questions of individuation and diachronic identity. Consider a surface under constant illumination over a period of time. Can we speak of a single microphysical event occurring during that time, and so treat the object's color as an enduring, stable feature? (If colors are properties of events, analogous questions arise.) Even in this most straightforward of cases, it is quite unclear what to say. Matters become only murkier if we consider more complex cases where the illumination changes. If, for instance, we think that the color of an object under constant illumination endures, what do we say about the case where the lights are turned briefly off and then back on? Does it matter how briefly? One might think that the mere need to consider such questions amounts to a kind of reductio of event physicalism. But I would suggest, to the contrary, that these questions *should* arise for any physicalist conception of the sensible qualities. Plainly they do arise for heat and sound (and odor). If theories of color have hitherto ignored such matters, then that again just points to the anomalous way in which color has been studied.

Reflection on such matters may well persuade the event physicalist that, at least with respect to color (and perhaps other sensible qualities), Heraclitus was right: that the sensible world is indeed in constant flux, each version lasting for only an instant. You can never see the same color twice.[12] But though it may be satisfying on some level to find one's ideas circling around to revisit the great dead heroes of long ago, it cannot be a good sign to find oneself talking like Heraclitus. To see what the problem is more precisely, consider that a theory of color has various desiderata to satisfy. Two have figured prominently so far: that the colors are represented in visual experience, and that they are the cause of visual experience. Presumably, though, there will be other desiderata on a successful theory. One might, for instance, suppose that the nature of color is revealed in visual experience.[13] Now it seems doubtful to me that this is a constraint that can be met by any plausible theory, to any serious extent. But when the event physicalist invokes Heraclitus, one might think that matters have gone too far—that vision reveals enough about color to tell us that they aren't like that. Here I think there is room to disagree. If the demand for revelation were to apply here, it would seem to apply equally to the case of heat, proving that heat cannot be molecular motion. Moreover, to the extent revelation matters at all, it may be satisfied here as much as in other modalities. For I myself—with some practice—have come to see colors as events, as a kind of constant flame (well, roughly) on the surface of objects. Indeed, when I look at colors this way, the experience of seeing seems to take on a new and richer character, as if I am only now understanding what I am seeing. At a minimum, then,

[12] And if Heraclitus was right about the sensible qualities, then familiar modern empiricist principles might be exploited to derive a thoroughgoing Heracliteanism about the natural world's evanescence.

[13] See, e.g., Johnston (1997).

I do not think that the demands of revelation pose a special problem for event physicalism, even of the most radical Heraclitean sort.

One might, however, charge that event physicalism contradicts quite directly and egregiously a further constraint on a successful theory: the desideratum that colors be stable properties. David Lewis, for instance, holds that an adequate theory of color must be commonsensical. Some compromise with common sense is possible, he writes.

> But compromise has its limits. It won't do to say that colours do not exist; or that we are unable to detect them; or that they never are properties of material things; *or that they go away when things are unilluminated or unobserved; or that they change with every change in the illumination*, or with every change in an observer's visual capacities; or that the same surface of the same thing has different colours for different observers. Compromise on these points, and it becomes doubtful whether the so-called 'colours' posited in your theory are rightly so-called (1999, pp. 332–333, emphasis added).

Event physicalism violates at least the first of the italicized maxims, and may (depending on its form) violate the second. The concern here is not just with contradicting the way we customarily talk about color (the sort of objection dismissed at the start of section two), but rather with contradicting what we *know* colors are. Lewis goes on to speak of it as a Moorean fact that the colors are, among other things, stable properties of objects. A theory on which colors change moment by moment, with every passing shadow, as we turn the lights off and on—this, one might contend, is not a theory of color at all, but a theory of something else (something for which we have no name).

Is this objection decisive? I think it is not. Lewis sounds suspiciously like an Aristotelian scholastic confronted with the modern notion that heat is molecular motion.

> Heat a kind of motion? We *know* that's wrong—we know that heat is a basic elemental quality, belonging to fire and air, that it has cold as its contrary quality, rather than merely its privation, that it is not a kind of motion. What you are talking about *cannot* be heat.

The appropriate response to such objections is to stress that such characterizations (of heat or of color) cannot be maintained a priori, without regard to science. It is no part of the meaning of 'heat' that heat be an elemental quality; similarly, it is no part of the meaning of 'color' that color be a standing property. In both cases, the terms refer to something represented in perceptual experience, or else to the cause of a perceptual experience. As I insisted earlier, theories of color should be driven by our best accounts in these areas, rather than by whatever pre-scientific prejudices we bring to the table. (The same point applies to the earlier argument from revelation: the fact that colors may not *seem* to be events is no argument at all against their being events.)

As for that old chestnut of whether there are colors in the dark, there seems no good reason to insist on any Moorean fact here. Intuitions are notoriously divided on the topic, and so what one should want out of a theory of color is simply a principled

answer that accounts for those divided intuitions. Standard physicalist accounts crack the nut in one way, whereas event physicalism offers a different resolution, treating colors in the dark like bells that are not presently being rung. Even if this response were hopelessly out of line with our intuitions, that would not be a decisive consideration. For, once again, what we want from a theory of color is an account that makes the best sense of colors as objects of visual perception. Moreover, to the extent intuitions do matter, the standard physicalist line looks to be in ever deeper trouble. As argued in section four, a consistent and comprehensive version of the standard theory must treat unplugged light sources as having color—not just having the power to become colored, but as actually colored. If our pre-theoretical intuitions count at all, they ought to count decisively against that consequence. Comparatively speaking, the denial that there are colors in the dark looks like sound common sense.

7 Broader implications

In the end, although I am sorely tempted, I am not saying that Heraclitus was right. There seems a great deal of unexplored territory here, and room for a range of alternatives that might more or less accentuate the theory's radical, Heraclitean character. Still, regardless of whether the theory will prove ultimately persuasive, it promises to reshape the larger debate in interesting ways. Suppose, for instance, that one accepts the argument from representation, and so concludes that neither dispositions nor standing properties can be colors. Suppose one also is persuaded by considerations like those offered by Lewis, and so thinks that event physicalism fails to describe anything that could count as a color. In that case, one would have a very strong argument in favor of color eliminativism. One would reason that what colors are, by their very nature, are the enduring features of objects represented in visual experience, but that *there are no such things*. In short, the eliminativist might well take the arguments of this paper as a reductio of the very idea of color.

On the other hand, suppose one finds color eliminativism absurd, but agrees that colors are enduring features of objects and not the sort of thing that can flicker in and out of existence. One might reach this conclusion through the argument from color constancy, or else by again invoking the Moorean principles that (a) there are colors, and (b) these are stable features of objects. In this case, one would have to reject the argument from mental representation, and so make room for a theory of colors as either standing properties or dispositions. But now it looks as if dispositionalism has the upper hand. The best arguments for the standing properties of standard physicalism, against dispositionalism, were the arguments deployed here in the service of event physicalism. If those arguments must be rejected, then it seems that the advocates of enduring color should favor a dispositionalist theory. From this perspective, it looks as if standard physicalism should no longer have a place in the debate—that it has been squeezed out by dispositionalism on one side and event physicalism on the other.

In a curious way, then, the present account of what true color physicalism would look like may do more to bolster the prospects of competing theories of color, and may end up persuading many that color physicalism is simply untenable. This is not my own view. I myself am so swayed by the argument from representation that I feel tempted to give up pretty well everything else we hold dear about color, if that is what it takes to maintain color's identity with the physical causes of visual experience. But with this new, clearer understanding of what those physical causes are, there comes a fresh sense of just how hard this road is.[14]

References

Averill, E. W. (2005). Toward a projectivist account of color. *Journal of Philosophy, 102*, 217–234.

Boghossian, P., & Velleman, D. (1997). Physicalist theories of color. In A. Byrne & D. R. Hilbert (Eds.), *Readings on color. Volume 1: The philosophy of color* (pp. 105–136). Cambridge, Mass: MIT Press (originally published in 1991).

Byrne, A., & Hilbert, D. R. (1997). *Readings on color. Volume 1: The philosophy of color*. Cambridge, Mass: MIT Press.

Byrne, A., & Hilbert, D. R. (2003). Color realism and color science. *Behavioral and Brain Sciences, 26*, 3–63.

Casati, R., & Dokic, J. (1994). *La philosophie du son*. Nîmes: Éditions Jacqueline Chambon.

Casati, R, & Dokic, J. (2005). Sounds. In E. Zalta (ed.), *The stanford encyclopedia of philosophy* http://www.plato.stanford.edu/archives/fall2005/entries/sounds/.

Hatfield, G. (2003). Objectivity and subjectivity revisited: Colour as a psychobiological property. In R. Mausfeld & D. Heyer (Eds.), *Colour perception: Mind and the physical world* (187–202). Oxford: Oxford University Press.

Hilbert, D. (1987). *Color and color perception: A study in anthropocentric realism*. Stanford: Center for the Study of Language and Information.

Jackson, F. (1998). *From metaphysics to ethics: A defense of conceptual analysis*. Oxford: Clarendon Press.

Jackson, F., & Pargetter, R. (1997). An objectivist's guide to subjectivism about colour. In A. Byrne & D. R. Hilbert (Eds.), *Readings on color. Volume 1: The philosophy of color* (pp. 67–79). Cambridge, Mass: MIT Press (originally published in 1987).

Johnston, M. (1997). How to speak of the colors. In A. Byrne & D. R. Hilbert (Eds.), *Readings on color. Volume 1: The philosophy of color* (pp. 137–176). Cambridge, Mass: MIT Press (Originally published in 1992).

Lewis, D. (1999). Naming the colours. In *Papers in metaphysics and epistemology* (pp. 332–358). Cambridge: Cambridge University Press (Originally published in 1997).

Nassau, K. (1997). The causes of color. In A. Byrne & D. R. Hilbert (Eds.), *Readings on color. Volume 2: The science of color* (pp. 4–29). Cambridge, Mass: MIT Press (Originally published in 1980).

Nassau, K. (2001). *The physics and chemistry of color: The fifteen causes of color* (2nd ed.). New York: Wiley.

Nassau, K. (2003). The physics and chemistry of color: The 15 mechanisms. In S. Shevell (Ed.), *The science of color* (pp. 247–80, 2nd ed.). Amsterdam: Elsevier.

O'Callaghan, C. (2007). Sounds: a philosophical theory. Oxford: Oxford University Press.

O'Callaghan, C. Sounds and events. In M. Nudds & C. O'Callaghan (Eds.) *Sounds and perception*. Oxford: Oxford University Press, forthcoming.

Pasnau, R. (1999). What is sound? *Philosophical Quarterly, 49*, 309-324.

Rossotti, H. (1983). *Colour: Why the world isn't grey*. Princeton, NJ: Princeton University Press.

Sorensen, R. (2004). We see in the dark. *Noûs, 38*, 456–480.

[14] Many thanks for their good advice to David Barnett, Matti Eklund, Michael Huemer, David Robb, and Robert Rupert.