

Towards A Relational Account Of Colours: A Critical Discussion of Hardin

Introduction

Hardin (1988, chapter 3) has recently defended a view in the philosophy of colour based around evidence that colours are not in any sense physical properties of objects which are commonly taken to be coloured. In this paper, I will perform 3 tasks. In part one of the paper I shall summarize Hardin's negative account which purports to demonstrate the wrongheadedness of his various opponents' theses. Part two will discuss his positive views (such as they are); part three will contain a discussion of where I think his argument is weakest and could use some more direct support from contemporary cognitive neuroscience and psychophysics. I shall sketch a few ways in which this could be done and attempt to provide greater unity for the account by placing it in an evolutionary framework.

Part 1:

In this section I shall explore Hardin's negative account. Hardin starts by quoting from Democritus concerning the conventionality of colour, telling us that even friends of science have been slow to acknowledge this. He then attaches names to each of several common positions concerning the status of colours. He calls objectivists¹ those who both hold colours to be properties of objects and properties of objects which would exist independently of any sentient observers. Correctly pointing out that this relies somewhat on common sense, he then describes the viewpoint of the so called subjectivists who think that colours are dispositions of objects to affect organisms under appropriate circumstances in a sensory fashion. He then explains that Democritus' viewpoint may be regarded as one particularly extreme form of subjectivism.

He then turns to remind us in outline of what is and what isn't known about optics, particularly what is known about light's interaction with matter that is not electromagnetic radiation², and correctly points out that quite a

¹ I find this choice of terminology a bit misleading. I would move that what Hardin calls "objectivists" should in fact be called colour realists, and "subjectivists" colour irrealists.

² I include EM radiation in matter as it is changeable (which is equivalent to saying that it possesses energy) in order to have the advantages of a scientifically justified monistic ontology. (See, for example, Bunge 1977 for explanations of the strength of this move.) This does mean that traditional formulations in the philosophy of perception have to be worded slightly different, but nothing will hinge on this distinction I am making. (Except, perhaps,

bit about this is known. He also discusses that less is known about colour processing in the human visual system, and correctly points out that a philosopher should be very wary about straying outside the bounds of current visual science (including physics, physiology and psychophysics). This is of critical importance, as we shall see later.

Next he sketches one version of the objectivist argument which asserts that colours are among the elementary properties of bodies, and marshals up several pieces of evidence against this viewpoint. He dismisses an account by Cornman as being metaphysically acceptable but epistemologically ridiculous. He does this by pointing out if colours are free of causal relations to physical properties they cannot have any affect on human functioning - either in brain states (he gives the example of beliefs) or in terms of observable behaviour.

With the Cornman account out the way, he moves into discussing the other form of (colour) objectivism. He discusses the view that "all <fill in a colour name here> things share a microphysical property in common" has already been falsified by work in this area. Similarly, he dismisses accounts that equate wavelength (of, say, light coming from a given thing - whether by reflectance or emittance, etc.) with a particular colour. This he does by pointing out that once a photoreceptor fires, all "information" about the wavelength that caused it to fire is lost. He considers other physical properties of objects that the objectivist might want to use, such as relative spectral energy of light sources, relative reflectance of opaque bodies and relative transmission of transparent/translucent bodies. Here he points out that these properties are indeed essential to perceived colour. But they cannot be identified with colour because of what is called metamerism - the if there are some strange ontological dualists who think that light proves their case or something of the sorts.)

I also note (related to the above remark) that I (like Hardin) am taking materialism for granted. This is simply to make sure that the background metaphysics to the discussion at issue is roughly compatible with the principles and findings of science; I shall assume throughout the present paper (though, again, see Bunge 1977 for reasons) that idealism and dualism are incompatible with science and thus beg the question against any account of colour consistent with it. Thus any possible objections to Hardin that rely on unscientific ontologies I will simply ignore. Should it be rejoined that I (or Hardin) is begging the question against the dualist/idealist, I would grant it but also point out that their position has a tremendous amount of evidence against it and hence the idealist/dualist very much has the burden of proof. (For numerous reasons of all sorts see Bunge 1977, 1981; Dennett 1991; Churchland and Sejnowski 1996 (1992); Petrides 1998. The latter four deal with the issue of dualism in the philosophy of mind directly, save Petrides 1998, which is a compilation of the sorts of neurological evidence that exists that the others have referred to indirectly.)

fact that coloured lights of different spectral composition can appear (phenomenologically) indistinguishable.

He then discusses the move that some have made - introducing the idea of a standard observer. Hardin then discusses how there appears to be no principled way of deciding what is going to be a standard perceiver and standard conditions. The position that he first discusses in this section is a weak subjectivism in order to show that a stronger form of subjectivism (his positive account) is desirable. This subsection begins with a discussion of how colour scientists use several "standard conditions" and how none of these have prescriptions or methods for discovering "the colour" of an object. To this end he points out that each account has some flaws (for example: how do we use daylight conditions to determine the colour of stars) and then moves on to a discussion of a large number of different proposals to "standardize" conditions, all of which are shown to have problems of a similar sort - each proposal works well for some cases and not for others³.

After finishing the discussion of environmental aspects to the "standard conditions" problem, he moves into the status of the subjects themselves. Equally here do we find problems with standardization. I find his use of dichromats in this regard is well founded. I shall have more to say on this particular issue later.

His next move is to ward off the philosophers who call colours produced during unusual circumstances (drugs, pressure on the eyeball, and many others) colour illusions. In section three (below) I will discuss these issues and integrate Hardin's explanation into a more general framework of cognitive neuroscience. (Generally, in science as well as in philosophy, it is best to build systems of ideas rather than producing isolated ones.) He is quite correct to point out that these features are often overlooked by supposedly science-oriented philosophers.

Hereafter, Hardin begins a discussion of the threshold of vision experiments. Part way through this discussion, he moves into the positive account, which I will discuss in the next section.

After the positive account, there are a few more negative remarks that follow, but by now he has canvassed so many of them and developed the positive

³ It may very well be objected that he hasn't covered all possible standardizations. I concede this point, however the large numbers of failed attempts both shifts the burden of proof, and "intuition pumps" towards the other camp in the debate.

account as far as he is going to here that I feel they are simply unnecessary and make the chapter a bit longer than it should be. I will not summarize them here.

Part 2:

Hardin's positive account begins in the discussion of subjectivism, during his account of the threshold of vision experiments. These experiments allow him to quite persuasively argue that the objectivist is required to say that an object's colour changes colour based on illumination, for she cannot consistently hold any illumination to be standard. But there is no property of the object which changes during the illumination differences, just our discrimination of it. Hence objects just cannot be coloured.

He also gives several examples from vision research not having to do with colour which also work positively. These include the noted waterfall illusion. I regard this as part of his positive account for it reminds us that very often there is no fact of the matter when two intuitive choices about something are presented. (In the waterfall case, it is neither the case that the "sense datum" of the rocks are moving nor not moving - they just simply are there. This is analogous to the threshold of vision experiment because the "sense data" in that case are (do not appear to be) neither coloured this way or that.)

Hardin's positive thesis ends there, and due to his negative thesis' strength, the chapter as a whole succeeds reasonably well. In the following section, I will offer some suggestions to strengthen it further.

Part 3:

In this section I will defend the view that Hardin's account of colour can be greatly strengthened with a few more facts gleaned from cognitive neuroscience and psychophysics. These facts are as follows: the existence of what is known as cortical colour blindness, further developments of the issues surrounding colour blindness generally, and a brief mention of a few other facts which are relevant to colour perception. In this section I shall discuss these facts and how they bear on the philosophy of colour by integrating them into an evolutionary context.

Cortical colour blindness (central achromatopsia) normally arises as a result of brain injury. A patient with this condition has no memory loss for colour (she is able to correctly pair the word "red" with "tomato") is yet unable to make colour discriminations. For instance, Sekuler and Blake (1994) summarize a case in which a patient with this condition was asked to use

coloured marker pens to shade a drawing from a children's colouring book. This patient was unable to correctly use colours in shading the drawing and took much longer than ordinary subjects deciding which marker pen to use for each area of the drawing. The patient otherwise had normal vision and further had intact cone photoreceptors of all three sorts. Remarkably, this condition can also be hemispherically localized, which has as 'phenomenological' consequence that someone can lose colour vision on one side of the visual field only (Rubens 1985). (What does this tell us about colours not being in the world, but instead being relational properties to a subject?)

The first thing it tells us is that the colour discrimination system in the nervous system is very distributed. It is not sufficient for colour perception to simply have light cause photoreceptors to fire - there must also be cortical activity as well. Secondly, as we shall see below, it links colour science with neurology. Those who claim that certain colours are illusions are thereby required to canvass neurological data to support their thesis, which as we shall see shortly, doesn't appear to be plausible.

A second consideration in this section is that there is also a very important case for the strong subjectivity of colours found in outline in the work of the philosopher Daniel Dennett (1991). Dennett's work actually contains a response to the work of Hardin's (1988) under examination here. I will present a simplified version which is enough for my own neurological account, to be presented in due course. Suppose all humans were all red-green colour-blind. We would have no name (presumably) for what we now call red and green; fire trucks, the Canadian flag, leaves in summer, grass and blood would all be "gred" (at least without any vision aids). Then if creatures like the way us, we would have no principled way to decide which group had "the correct" colour vision⁴. This point can be reinforced by a thought experiment in which red-green colour blindness is (presumably artificially) selected for in humans and the trichromats become extinct. Are the remaining humans all suffering from a colour deficit? Surely not, for if a mutation brings back in the trichromacy, we would probably want to say that these "new" people have a unique ability. (If we regressed societally and forgot our colour science we might even say that these "new" trichromats had a divine gift!)

Dennett also suggests a way in which the "subjectivism" that these considerations produce can be rendered a bit less extreme, while still maintaining the important features of Hardin's account. He suggests we play the evolution card, which I think is good, for the following reason. It

⁴ In short, this thought experiment is to show how "chauvinist" we are about colour.

reminds us that humans and other animals have colour vision - to discriminate amongst features in the environment. It is hence no surprise that we see green and red as maximally opposed. Fruit that was advertised as ripe would be selected for, just as discriminators that could maximally discriminate between subtle biochemical differences as evidenced by optical interaction. This interactionism yields the relational view of colour, discussed in the rest of this paper as a way of "buttressing" Hardin's account.

Evolution also gives us a hint as to why so many other things can look coloured to humans. While human discrimination systems (and as we have seen that includes at the very least photoreceptors and various cortical areas) evolved to discriminate certain kinds of differences, but evolution doesn't give things neat boundaries. The neural system can be influenced by things that it was never "designed" to handle by coincidence. Just as humans didn't evolve to have an appreciation for music, they can use their evolved ears and brain to enjoy Mozart or whatever music desired. Note also that this account allows vision to be seen as being more closely related to other senses than what would be on an objectivist account. (I don't know of any taste or smell objectivists - why is this?)

Work in neural networks also bears out this account of the evolution of relational properties. Neural networks have the fascinating property that they can do partial matches without requiring a (neurologically dubious) explicit representation of propositions⁵. The work in this area (for example, as reported in Churchland and Sejnowski 1996 [1992]) is promising when it comes to other aspects of vision; colour "partial matches" seem that much more plausible now. Partial matches support the relational view as follows. If a collection of neurons evolved to discriminate one particular pattern of light, it would have a certain probability of firing given other conditions. These other conditions need not be simple "partial matches" of the conventional sort. The work with neural networks should also remind us that neuron firing occurs statistically - this again suggests that discrimination abilities could very well get "gerrymandered" for other uses. Note also that this consideration explains why colours can be produced by hallucinations and so on. As is well known, neurons can be made to fire for other reasons than what they evolved to detect by other physiochemical means (drugs, pressure, electric discharge) because they aren't "cleanly engineered systems". Even if they were, any "design" has occasional side-effects that can be exploited now and then.

⁵ For instance, that contained in the work of Jerry Fodor. See Medin and Ross 1997 for details on why "propositional form" representation is neurologically dubious.

Hardin quite thoroughly amasses evidence for the negative part of his thesis, but as we have seen, could have more thoroughly developed a positive account, which I will now briefly outline. All the considerations we have seen above drive home the viewpoint that colour is in some sense a relational property. A relational property is just simply a property that is of a pair (or in general, a collection) of things.

Relational properties are nothing new in other sciences⁶; why should neuroscience and psychology be afraid of admitting such things? In fact a perception text by Sekuler and Blake (1994) commits to the relational view; other work in cognitive neuroscience, such as amassed in Petrides (1998) also shares this viewpoint. Hence the relational view should be amenable to Hardin, as he has already committed to wanting to not contradict the current best science.

This viewpoint also has the curious consequence of making the extreme subjectivists ("it is all in your head") and the objectivists ("it is outside your head, in objects") understandably talking past each other because they were both half right. On the relational view, colours are "in both", so to speak. If nothing of any optical discrimination abilities were to be around at any moment in time (say, before the first photopigments evolved on earth), nothing had any colour or everything did, depending on how one wants to look at the counterfactual. If there was sulfur in a rock, it would look yellow to humans as it does now, *ceritus paribus*. But it would also look the same colour as the rock to a creature who was not sensitive (either "directly" or by chance) to the relevant differences. This is well within the viewpoint of the "subjectivists" of colour, because we know in actual fact before there were discriminators there weren't really any colours - just, one might say, "potential" colours. Nor are there any colours in a situation where a discriminator can't discriminate.

Now that I have outlined the relational account, I will answer two questions that an objector might want to ask. Firstly, I may very well be asked: what differences? And the answer is quite straightforward - whatever is

⁶ We have known since at least 1916 and the general theory of relativity that space and time are relational properties, to use one well known example. Note, however, that in the case of physics, relational properties do not involve subjects, where as in psychology they may. (They need not, as the discriminatory ability of bees to sense certain kinds of ultraviolet radiation and see certain patterns in flowers that (say) humans cannot does not necessarily commit one to saying that bees are subjects.)

discriminated by some class⁷ of observers. As is pointed out by Hardin repeatedly, there are lots of things that these properties could be. Humans are not terribly discriminating. Hence there could very easily be creatures more so; or even less so. This also allows us to make an answer to another question. How many "potential" colours are there? Answer: the cardinality of the set of the cartesian product of possible discriminations with that of the possible discriminators, which is at least a countable infinity of possible colours. (No one discriminator would be capable of such discrimination, of course.)

Another question some may have to ask in response to this account is: why do colours appear so basic if what we are picking out is such a hodgepodge of things? Hardin doesn't give a satisfactory answer to this objection. There is quite a simple one, though. For any discriminator, there has to be a determinate stimulus that causes it to register the smallest unit of discrimination. This is on pain of infinite regress. A person sees a horse - then they break it down into tail, head, body, legs (for example). Then they can break down the head into ..., and so on. At some point, this process stops. Some of the basic "units" of discrimination (namely, the optical ones) are what we call colours. But since the "units" of discrimination are both a property of the external things and of our brains, we have again evidence for the relational view of colour. (This is because we are more sensitive in certain areas of the spectrum than others, even in the band we can see. See Sekuler and Blake 1994.)

Conclusion

We have seen that although Hardin's negative account is largely successful, his positive account could use some shoring up. I have provided several ways in which this can be done, drawing on cognitive neuroscience, psychophysics, evolutionary biology, etc., and hopefully provided some greater insight into the strange world of colour.

⁷ As the existence of humans with less than trichromatic vision shows us, these classes need not be species.

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