Perceptual Pragmatism and the Naturalised Ontology of Colour

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This paper considers whether there can be any such thing as a naturalised metaphysics of colour—any distillation of the commitments of perceptual science with regards to colour ontology. I first make some observations about the kinds of philosophical commitments that sometimes bubble to the surface in the psychology and neuroscience of colour. Unsurprisingly, because of the range of opinions expressed, an ontology of colour cannot simply be read off from scientists' definitions and theoretical statements. I next consider two alternative routes. First, conceptual pluralism inspired by Mark Wilson's analysis of scientific representation. I argue that these findings leave the prospects for a naturalised colour ontology rather dim. Second, I outline a naturalised *epistemology* of perception. I ask how the correctness and informativeness of perceptual states is understood by contemporary perceptual science. I argue that the detectionist ideal of *correspondence* should be replaced by the pragmatic ideal of *usefulness*. I argue that this result has significant implications for the metaphysics of colour.

Contents

1 Naturalised Colour Ontology—the Very Idea

The debate over colour ontology concerns questions such as, "what kind of properties are colours?", "are they instantiated in ordinary objects?", "are the colours *real*?". Theories of colour offer answers to such puzzlements and are also associated with specific views on the epistemology of perception. For the purposes of this paper I will delineate three broad classes of theory:

Physicalism Colours are intrinsic (perceiver independent), physical properties of ordinary external objects. Ordinarily, colour perception is veridical.

Eliminativism Colours are not instantiated in ordinary external objects and so ordinary colour visual experiences of objects are in fact illusory.

Relationism Colours are relational (perceiver dependent) properties of ordinary external objects. Colour perception is usually, maybe always, veridical.

In this paper I discuss the prospects of different kinds of naturalised ontologies of colour—that is metaphysical theories of colour that are in some way derived from the empirical science of colour, in particular perceptual science. My motivation for exploring the methodological options stems from the fact that the philosophy of colour has long been engaged with empirical results, but there has been relatively little discussion of the methodological issues arising from the infusion of data into these debates. Furthermore, there has recently been an explosion of interest in naturalised metaphysics in other areas of philosophy, so it is worth seeing how this work can inform methodological issues around colour ontology.

In his introduction to a recent collection on naturalised metaphysics Kincaid (2013, 2), following Reichenbach, characterises "scientific philosophy" as the use of "scientific methods and results to solve problems arising from science that are roughly philosophical in nature."[1] As I have argued at length elsewhere (Chirimuuta, 2015, chap. 2), the problem of colour ontology needs to be situated in the context of the changes in broad metaphysical outlook which accompanied the rise of modern science in the seventeenth century. So in this sense colour is a philosophical problem which arises from science. It is less clear, however, that anyone could use scientific methods and results to solve it.

As we will see shortly, sometimes clear conceptual claims do emerge from the scientific community, ones which seem to make transparent the ontological commitments of the empirical endeavour. Yet there is a striking lack of consensus amongst scientific theorists. So the danger in taking any one such claim to be *the* naturalistic colour ontology is that with a little more digging one easily uncovers alternative claims which bolster rival ontologies. To

[1] In this book the terms "scientific metaphysics", "naturalised metaphysics" and "scientific philosophy" are used pretty much interchangeably. Likewise, I will not make any distinction amongst them for the purposes of this paper.

illustrate this point, in Section 2 I will discuss some quotations from vision scientists which can be taken as expressions of the three important theory types: physicalism, eliminativism and relationism. On pain of inconsistency, an ontology of colour cannot simply be read off from scientists' definitions and theoretical commitments.

In other words, I do not propose that the naturalised metaphysics of colour be a purely descriptive activity—some simple transcription of a shared core of scientists' theoretical beliefs. This suggests that there should be some normative dimension to the inquiry. Metaphysics is frequently conceived, these days, as the Sellarsian project of finding out how the broadest range of our ideas can best hang together. On such a view, the role for the naturalistic philosopher of colour is to take, as building materials, the theoretical commitments that are implicit in scientific practice, and construct from them a framework—an account of what colors are—which makes a good scaffolding for future scientific discoveries. It must also be well positioned within our larger philosophical edifice. In other words, it must not land us with views which we have antecedent philosophical reasons to reject. In taking on such a project, the naturalistic philosopher is not required to find a place for every theoretical commitment she finds in the science. Pieces which are inconsistent with the others, which cannot be well placed within the framework, may be left aside.

After considering Wilson's proposal to radically fragment our concept of the colours (Section 3), I present my positive proposal (Section 4). It turns on the idea of *perceptual pragmatism*, which is itself a reconstruction of a naturalistic epistemology of perception. I discuss how the truth and informativeness of perceptual states is understood by contemporary perceptual science. I argue that the commonplace idea that perceptual activity aims at *correspondence* between external stimulus and inner states should be replaced by the pragmatic ideal of *usefulness*. This follows from some truisms of perceptual science, the primary point being that perceptual systems do not deliver any uniquely true description of the world; instead, each description is partial and interest relative. So while one cannot read off a consistent ontology of colour from scientists' theoretical statements, a more uniform epistemology of perception can be derived from the scientific "orthodoxy", and this is significant for the problem of colour ontology. At the end of the paper I will sketch out the ontological lesson that is implicit here, arguing that colour relationism offers important resources for getting clear on the scientific understanding of perceptual success, and that it suggests an interesting avenue towards rethinking what we mean by realism.

2 A Spectrum of Views

In a *Journal of Philosophy* article Hardin (2003, 191) writes that, "it is a curious sociological fact that many philosophers, but very few visual scientists, are color realists." To be a colour realist is to hold that colours are perceiver independent properties that are instantiated on the surfaces of things, whether or not anybody is there to look. What the realist denies is that colour is in any way a by-product of neural activity. This is the central tenet of eliminativism, a view that Hardin (1993) has defended at length, drawing on vision science

as a source of inspiration. In agreement with Hardin's eliminativist theory, vision scientists have variously claimed that colour is identifiable with states of the brain, or that it is created or constructed by the brain:

> At this point in time our ideas concerning the nature of color are still largely speculative. For now, the most convincing account, in conflict with few if any facts, is that color is identical to a particular brain state. (Kuehni, 1997, 26)
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> We know from psychophysical and neurophysiological investigations that color is created somewhere in the brain, although the exact location of this process is still unknown, and we even have no idea what entities the sensations called color are. . . . In short, colours appear only at a first naïve glance to be located in objects. (Backhaus and Menzel, 1992, 28)
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> The results described here . . . suggest that *the nervous system, rather than analyze colours, takes what information there is in the external environment, namely, the reflectance of different surfaces for different wavelengths of light, and transforms that information to construct colours*, using its own algorithms to do so. In other words, it constructs something which is a property of the brain, not the world outside. (Zeki, 1983, 764)(emphasis in original)[2]

However, in making his sociological claim, Hardin is ignoring the numerous scientists working in the field of computational colour constancy who do express views *akin* to the kind of colour realism or physicalism which identifies colours with classes of *surface spectral reflectance* (SSR) [Hilbert (1987), Matthen (1988), Byrne and Hilbert (2003)]. For instance, when reviewing his colour constancy research, Maloney (2003, 285-286) introduces the notion of "intrinsic colour". He defines this as the "objective correlate of the perceived colour of a surface" which, he adds, could be measured by some computation of the surface's reflectance. Like the physicalists [Tye (2000, 147-8); Hilbert (1987, 65)], Maloney interprets the phenomenon of constancy as our recovery of a stable property existing independently of us; the difference is that Maloney does not explicitly *identify* colour with that intrinsic surface property.

In order to study how humans achieve colour constancy, it is fairly intuitive to frame the problem in a realist way: to say that colour constancy is about the recovery of a hypothetical objective property. This leads researchers to posit primary-like qualities, "intrinsic colours" and then develop models of how these might be recovered. Yet as I have discussed elsewhere (Chirimuuta, 2008), this is not the *only* theoretical approach to constancy. So physicalism is by no means a commitment of colour constancy research, even though it does harmonise with some colour constancy models.[3]

[2] All quoted by Byrne and Hilbert (2003). Cf. Sekuler and Blake (1985, 181), Zeki (1983, 764) and Goldstein (1989, 140).

[3] But see Hurlbert (2013) who argues that colour constancy research is not compatible with reflectance realism. One important point is that scientists working on colour constancy, including Maloney, take constancy to be a global phenomenon, such that perceived colour depends not only on the local surface

I now want to emphasise that the idea that colour is (at least in part) created or constructed by the brain *is* compatible with the group of theories known as colour relationism. The core relationist thesis is that colours are "constituted in terms of a relation between (*inter alia*) objects and subjects" (Cohen, 2009, 8). For example, if the property turquoise is thought of as the disposition of the tropical sea to cause me to have a characteristic turquoise-y visual sensation, given the right lighting conditions, then we can say that turquoise is a property actually instantiated in the tropical sea, but that this property is perceiver-dependent. One way to cash out the perceiver-dependence of turquoise is in the idea that the brain has a role in "constructing" this colour in response to the sea (by partly governing how the turquoise disposition of the sea will be manifest).[4]

Thus, as Giere (2006, 32) observes, one of the textbook passages which is frequently quoted as an example of eliminativism is as much an expression of relationism:

> Color is a *psychological* property of our visual experiences when we look at objects and lights, not a *physical* property of those objects or lights. The colors we see are based on physical properties of objects and lights that cause us to see them as colored ... but these physical properties are different in important ways from the colors we perceive. Color is more accurately understood as the result of complex interactions between physical light in the environment and our visual nervous sytems. (Palmer, 1999, 95)
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> There may be *light* of different wavelengths independent of an observer, but there is no *color* independent of an observer.
> (Palmer, 1999, 97) (emphasis in original)

Palmer's primary point here is that we cannot identify colour with a perceiver-independent physical property. As Fairchild (1998, xv) also writes, "without the human observer there is no color". This is, of course, in keeping the relationist thesis that colour must be understood in terms of the relationship between objects and observers (including non-human perceivers). An anti-realist theory like Hardin's only follows *if* one assumes that perceiver-dependence is incompatible with the reality of colour.

3 Conceptual Pluralism

The debate between physicalists, on the one hand, and relationists, on the other, is often characterised as a debate over whether colors are primary or secondary qualities. Mark Wilson's *Wandering Significance* is a recent work in the philosophy of science which deals extensively with the concept(s) of colour, and how they fit into scientific representations. In

but also the entire scene [Kraft and Brainard (1999); Hurlbert (1999)]. Whereas physicalists do not allow for any context dependency of colour itself. I thank an anonymous reviewer for raising this point.

[4] I should emphasise that this is *my*—but not Cohen's or the traditional dispositionalist's—preferred way of developing the relationist thesis (Chirimuuta, 2015, chap. 6).

order to shake us out of our convictions about the sharpness and importance of the primary-secondary distinction, Wilson (2006, 6.ix) dwells at length on the puzzles surrounding the seemingly innocuous concept of "hardness". Thomas Reid asserted that hardness was a straightforward primary quality, corresponding to the cohesion of the invisible parts of a body. Descartes, on the other hand, conceived of hardness as a response-dependent, secondary property, the disposition of a body to resist any pressure we exert on it, which we in turn associate with a specific sensation of hardness. Wison's aim is to convince us that there is something wrong with both views. His central claim is that there is no *one* concept of "hardness" that orchestrates all of our various uses of the term. For instance, no one test of hardness (scratching, tapping, applying pressure) is appropriate for all the materials whose hardness we might want to assess, and no one physical characteristic, such as cohesion or rigidity of micro-structure, accounts for the hardness displayed by very different kinds of substances. Hardness can display a "multi-valuedness"—different tests of hardness can yield conflicting results as to the relative hardnesses of substances, and we would not have grounds to claim that either one of them is the true indicator. The upshot is that, "*hardness* proves to be neither a simple physical quantity nor a constant sensation, but an informational package with characteristics sui generis of its own" (Wilson, 2006, 351).

The next point is that colour and hardness are on precisely the same footing.[5] Wilson argues, our philosophical troubles stem from the assumption that there must be *one* governing concept of "redness" which accounts for all of our dealings with this term, one which has its source in a canonical sensation of redness. Instead, we have various ways of ascertaining the colours of objects, employing different and more or less exacting lighting and viewing conditions. Most of these assessments provide useful information about the physical nature of the object, and for different practical purposes some methods of colour "measuring" are more apt than others. For example, technologies of colour reproduction such as the manufacture of paints and dies, require exact matching of pigments from one occasion to the next, so decontextualised viewing through reduction tubes is particularly useful. Those concerned with colour design must take into account surround contrast effects, so colours need to be seen in their intended context (Wilson, 2006, 456).

Wilson concludes that redness is as objective a property as others, such as hardness. But we must note that Wilson's notion of objectivity is very different from the one which colour physicalists aspire to. The metaphor of the atlas is telling. Wilson often compares the locally defined use of a concept to a map, and the collection of concepts bound together under one

[5] [T]he predicate "red" is swayed by a swarm of multiple directivities and doesn't reflect any core unity at all. As with "hardness," "red" (most of the time) conveys substantive physical information about its objects (roses, fire trucks, neon lights, etc.), but the nature of this information differs widely from target system to target system. The word's behavioral oddities stem from the same basic circumstances as engender those of "hardness": we lack the tools to settle a predicate of comparable utility on anything other than an uneven platform patched together through natural continuation. The mild inconveniences so occasioned do not greatly compromise the local objectivity of the physical information conveyed, but they do require us to take . . . precautions in working with claims about "redness" especially over a wider scale. (Wilson, 2006, 393)

word, such as "force", as an atlas. Maps are not regions of the Earth, but representations humans have devised in order to find their way around. As Wilson (2006, 6.ii) discusses at length, any projection of three dimensional geography onto a 2D surface involves distortion, and our practical intentions determine which distortions will be tolerated and where we must place a premium on more veridical projections. When I use my chromatic vision in order to assess the weather conditions that are indicated by the changing spectrum of the light I am tolerant of the colour *in*constancy of material surfaces in a way that is completely at odds with the requirements for constancy placed when, for example, I try to find the best viewing conditions to look at fabric samples for new blinds. The different uses of colour, both in my perceptual experience and linguistic communications, are different processes for finding out about my surroundings but they are both, in some sense acknowledged by Wilson, human centred devices. In contrast, physicalists have asserted that colours are simply part of fabric of the perceiver-independent world.

In short, Wilson employs his sophisticated account of scientific concepts in order to demonstrate the shakiness of the primary-secondary distinction and the sense in which colour can be said to be an objective property. Thus we might conclude from Wilson that a naturalistic colour ontology is some kind of reformed physicalism. But if Wilson's picture of scientific representation and concept formation is broadly correct, then it is difficult to see how we can proceed from our understanding of scientific concepts to any precise ontological thesis about the colours. If naturalized ontology of colour must attend to colour concepts as they arise from scientific and technological practice, and such practices are by their nature various, then at most we will have a range of naturalized ontolog*ies* of colour. At worst, our philosophical project will be confined to exploring the complex terrain of human conceptualisation and is more accurately described not as metaphysics but as conceptual analysis.

4 Perceptual Pragmatism

We have seen that because of the lack of consensus between different research traditions there is a serious problem with any attempt to read off a naturalistic colour ontology directly from scientists' conceptual claims. Moreover, if Wilson is right, the very concept of colour employed by science is a fragmented one. So how might perceptual science offer revisions to colour ontology? My proposal is that we should first take an excursion to the naturalistic epistemology of perception. By this I mean we should examine the ways in which scientists have addressed questions such as the following:[6]

- What does it take for a perceptual state to be *right*?
- How does perception inform us and other animals about the environment?

[6]Note that this notion of "epistemology" does not give an account of knowledge with a capital K. The account really is delimited by these three questions.

- Under what circumstances can perceptual states be said to be illusory?

In order to recover the answers to these questions that are implicit in perceptual science I will begin by setting out four "truisms" of the discipline. These are commonplace assumptions that I believe are almost universally accepted by researchers.[7] I will then argue that by considering these points, one is able to outline a minimal epistemology of perception which is assumed in scientific research. This is the view I call *perceptual pragmatism*, and it should be taken as a philosophical articulation of the minimal perceptual epistemology that is in the background of the empirical research. Perceptual pragmatism can be characterised through the contrast with a perhaps more intuitive, and philosophically dominant epistemology of perception. Whereas the dominant view takes perception to be a kind of detection of objects and properties in the world, which aims at a matching between inner and outer states, perceptual pragmatism treats perception as a kind of interaction with the world that is more active and interest-relative than the rather passive process of detection. On the pragmatist view, the ideal perceptual state is simply one that is useful to the perceiver, not one which can make a claim of correspondence to perceiver-independent states of affairs. So following the delineation of the four truisms I will flesh out the perceptual pragmatist approach by discussing the detection–interaction, correspondence–utility and passive–active contrasts. Here are the four truisms or starting assumptions:

1. Perception is an action-guiding interaction between perceiver and environment.
2. Perceptual systems do not deliver a uniquely true description of the world.
3. Each description is partial.
4. And each description is interest relative.

The first point, that the process of perception is an action-guiding interaction between an animal and the extra-dermal environment, seems hardly contestable. What bears emphasis, though, is that I have deliberately focussed on "interaction" as an (almost) neutral starting point. To say that perception is an interaction is to say simply that when an animal perceives, something goes on in the environment, and something happens in the animal, and that these two goings-on are related to one another in an important way. One *could* go further and say that this interaction is supported by a particular type of causal mechanism. But that would be to load up with theoretical commitments that were not there at the

[7] Of course one can find statements that break with this dominant view if one looks in the perceptual science literature. Does this mean that we fall back into the pluralism which I have been trying to avoid? Not if we remember that the project here is partly constructive and not just descriptive. To appeal to the building metaphor, a certain number of bricks and stones (statements espoused by scientists or commitments of specific theories) may be rejected in favour of others which more neatly fit within the larger theoretical/philosophical edifice.

outset. In Section 4.2 I will talk about one very entrenched way of characterising the interaction: the detection model.

The significance of this first point is that it highlights the fact that perception is not an inner process like (ideally) the circulation of blood. As such, in order to understand perception researchers have to direct attention both to the inner mechanisms of the sensory system and the environment that they are responsive to. This is common ground between researchers of very different theoretical persuasions—Gibsonians and Marrians, ecologists and computationalists.[8] Furthermore, it is uncontroversial that perception is there for guiding activity—finding food, avoiding predators, etc.. The implications of this will be discussed in Section 4.1.

The second item might sound more contentious. But let me be clear that by "description" I do not mean anything so concrete as a "representation". The point is just that if one considers perception beyond the narrow human example one finds an incredible variety of different kinds of sensory systems which make possible an array of states that humans literally cannot imagine.[9] Thomas Nagel, famously, could not imagine what it would be like to be a bat and to fly around at night guided by echolocation. For myself, I cannot imagine what it would be like to be homing pigeon endowed with pentachromacy (as opposed to boring human trichromacy), magnetoreception, and possible sensitivity to the direction of polarisation of light. In some sense the perceptual systems of the bat and the pigeon must be "describing" the world differently. Nobody would argue that any of these creatures has *the* correct way of apprehending the world. This is because each description is partial, as stated in point 3.[10] For instance, what the honeybees gain in the ability to detect patterns of ultraviolet light, they lose (in comparison with humans) in their inability to see patterns of long wavelength light; dogs may hear at higher frequency than we can, but we can see more colours. It is beyond doubt that no animal who has ever walked the Earth has ever been responsive to all possible perceptual stimuli (i.e. *all* the frequencies of sound waves that some animals can hear, all the frequencies of light waves that some animals can see, all the possible chemicals that some animals smell and taste, plus all of the exotic sensory modalities like sensitivity to magnetic fields) (cf. Wolfe et al. (2006, 3)).

Since animals are limited in what they may sense, it pays to choose wisely. The fourth point follows from the third. In saying that a description is "interest relative" what I mean is that the practical needs that a perceptual system must meet will have a bearing on what is perceived, and the manner in which it will be perceived. For example, a species which uses vocalisations as a means of communication will have an auditory system sensitive to those sounds; there is no point having a sense of taste if it can never discriminate nutritious from poisonous foodstuffs. This point again should be uncontroversial, though I have been careful to phrase it in a way which will not immediately raise accusations of adaptationism.

[8] See footnotes 14 and 16. Mausfeld (2010) is one dissenting voice here.

[9] See Prete (2004) to get a sense of the alienness of invertebrates' sensory worlds. A classic study on this theme is von Uexküll (1957).

[10] "[S]ensory systems are actually filtering systems that let in only the information that is potentially biologically meaningful" (Prete, 2004, 3).

In his book *Seeing, Doing, and Knowing* Mohan Matthen provides an important discussion of the tight connection between perception and the practicalities of life, but goes as far as to say that each system has evolved to serve a particular function (Matthen, 2005, 206). It is not hard to find counter-examples to this claim—for example creatures which spend their lives buried in mud but have perfectly good colour visual systems (Chittka and Briscoe, 2001). So my assertion is just that at a certain level of generality it makes sense to say that perceptual systems serve a function and that this implies that the "descriptions" they yield are interest relative.[11] I will now say more about the perceptual pragmatist account by comparing it with the non-pragmatist foil.

4.1 Correspondence and Utility

At the heart of the view I call perceptual pragmatism is the rejection of the correspondence theory of perceptual accuracy. In answer to the question, "what does it take for a perceptual state to be right?", the perceptual pragmatist replies, "it must work—it must be a *useful* guide to the surrounding environment." This is in contrast to a view more dominant in the philosophy of perception which says that a perceptual state is right if it is veridical—if its contents correctly correspond to states of affairs in the surrounding environment.[12] If the rejection of correspondence as the standard of evaluation for perceptual states is the more radical move, why should one be tempted by it? The primary reason is that it gets to a core commitment of perceptual science.

Consider the question, "what are perceptual states for?". A natural response is, "to tell us what is where". This chimes easily with the correspondence way of thinking, but it is not the most fundamental of responses. The answer that predominates in perceptual science is, "to help you to live by guiding your activity in the world"[13], and "telling you what is where" is but one way to achieve this. From the naturalistic perspective, having something that works is the key constraint on perceptual systems, not accuracy for the sake of accuracy. Something like the contrast between correspondence and utility based analyses is discussed by Palmer (1999, 6-7) who writes that, "perception is *not* a clear window onto reality, but an actively constructed, meaningful model of the environment that allows perceivers to predict what will happen in the future so that they can take appropriate action and thereby

[11] Cf. Goldstein (1999, 258-259): "perception evolved for the purpose of survival, and ... the variations in perceptual mechanisms we can observe across species reflect the specific survival needs of each animal. One of the best ways to draw a connection between perceptual mechanisms and survival is to consider the eye—a structure found throughout the animal kingdom, but in different forms that are designed to meet each animal's specific needs."

[12] The commitments of pragmatist philosophy have been contested from the very beginning of the movement. In introducing the term "perceptual pragmatism" I do not mean to claim the whole tradition, but only to allude to a source of inspiration. One theme of American pragmatist philosophy—at least in the more "relativist" lineage from William James (James, 1907, Lecture VI) to Richard Rorty (e.g. Rorty (1979))—has been the rejection of the correspondence theory of truth (see Misak (2013) for discussion and criticism of this lineage).

[13] E.g. "Human senses have evolved to help us act in ways that encourage our survival" (Wolfe et al., 2006, 3).

increase their chances of survival."

Consider the much abused example of the frog's "bug detector"—the reflexive tongue lash in response to peripheral visual stimulation. Following Barlow (1953) it is commonly held that this visual-motor loop serves the frog by finding and capturing food. The implication is that it would be inappropriate to impose some abstract standard of correctness on the frog's visual states, such as the precision with which they relate the fly's shape and contour, or even the ability to deliver internal states that reliably correlate with the presence of specific external objects. In order to interpret and analyse *what* the animal selects to find out about its environment, and *how* that information is conveyed, one must be cognisant of the needs of the animal, and its behavioural repertoire (e.g. whether it is nocturnal or diurnal). This is because perceptual "descriptions" are inherently selective and interest-relative. In ignoring this, one risks a distorted image of one's topic of enquiry and will likely miss valuable information.[14]

However, that is not to say that accuracy in reporting the distinct shapes of flies is necessarily irrelevant. If the frog lives in a location where almost identical looking edible and poisonous flies co-exist, then the animal will need a system sensitive to their subtle differences. In other circumstances, having a more acute visual system could even be detrimental to the frog, e.g. because of the additional cost it would take to build a, larger, more discriminating eye.[15] In sum, the question "what does it take for a perceptual state to be right?" can only be addressed by first considering the system's function or use. Correspondence and accuracy are secondary considerations.[16]

[14] In the concluding chapter of the textbook *Visual Perception* the authors reject the Gibsonian ecological framework, in favour of the Marrian computational one. Even so, they assert that the insights of ecological psychology are a crucial component for understanding visual representation and processing. They write that, "[i]t is in understanding how simple animals such as flies perceive their surroundings that a combination of the two approaches [ecological and computational] has achieved most success, specifying the ecological problems vision must solve for the animal, devising appropriate algorithms, and unravelling their implementation by the nervous system" (Bruce et al., 1996, 379).

[15] "Visual information is only useful if the animal can improve its behaviour on the basis of it. For every species there is thus a limit to how much spatial information it can use. There is, of course, also a cost involved in making and maintaining eyes, and it is this final balance which determines how much vision each species can afford" (Land and Nilsson, 2002, 10).

[16] It might be objected that the computational tradition in vision research, exemplified by the work of David Marr and discussed in detail by Burge (2010) is very much committed to the correspondence-detection model. As Marr (1982, 6) notes, this tradition is an extension of representational theories of mind which were dominant from the seventeenth to nineteenth centuries, so it is hardly surprising that it shares something of the correspondence thinking that characterises this approach to the philosophy of mind and epistemology. Yet even so, Marr (1982, 32) makes it very clear that any analysis of the representations which on this view constitute perceptual states must make reference to the particular tasks for which those representations are suited: "Vision ... is used in such a bewildering variety of ways that the visual systems of different animals must differ significantly from one another. Can the type of formulation that I have been advocating, in terms of representations and processes, possibly prove adequate for them all? I think so. The general point here is that because vision is used by different animals for such a wide variety of purposes, it is inconceivable that all seeing animals use the same representations; each can confidently be expected to use one or more representations that are nicely tailored to the owner's own purposes." It follows that no one of these representations is *the* correct description of the environment.

4.2 Detection and Interaction

It might well be objected that the correspondence view that I have just sketched as a foil for perceptual pragmatism is a straw man: for no-one would claim that perceptual systems should be evaluated by standards entirely abstracted from any ecological and behavioural context. So to make the contrast between the two outlooks clearer I will now say more about an initially appealling way of understanding perception in terms of inner-outer correspondence: the detection model. In seeing the limitations of this model the virtues of perceptual pragmatism will come into sharper focus.

In response to the question, "how does perception inform us and other animals about the environment?", the perceptual pragmatist will reply, "in virtue of some kind of perceiver-environment interaction". This leaves the nature of the interaction open, for the time being, though I will say more about it in Section 4.3 below. In contrast, someone committed to the correspondence view will typically give a more pointed reply: "because perceptual systems are able to detect surrounding objects and their properties." This process of detection need not be restricted to simple sensory transduction, such as the photoreceptors' detection of incoming photons; it may involve a complex reverse optics calculation or Bayesian inference from proximal sensory stimulation to the most probable distal object (Burge, 2010). Yet the basic idea is that the perceiver is concerned to know what is where, and that some elaborate process of detection is employed in order to achieve this.[17]

I will follow Kathleen Akins in rejecting this model for the reason that it becomes stretched or empty when one examines real perceptual systems. The correspondence-detection model begins with the idea that perceptual systems report on the external world "without exaggeration or omission" (Akins, 1996, 344). The governing metaphor is that sensory and perceptual systems are like a technician's measuring devices—for instance, that our systems for thermoreception are like the body's own thermometers. But actual perceptual systems do not conform to the expectation that they veridically report on external events without bias or distortion. Instead, they are typically "narcissistic", which is to say that their ineradicable self-interestedness gets in the way of their ever achieving a neutral (i.e. perceiver-unrelated) view of the world (Akins, 1996, 345). For example, the responses of thermoreceptors on the skin do not correlate with fixed dermal temperatures, but they do signal events of rapid heating or cooling which could lead to tissue damage.

Now an adherent to the correspondence-detection model could simply say that what states of the system correspond to are not temperatures, *per se*, but something more related to the perceiver's interests, like "thermal perils". But what must then be conceded is that

Each representation can be assessed according to how well it enables the perceiver to do particular tasks.

[17] Pautz (2013) characterises an influential version of the detection theory, which he calls "tracking intensionalism": "The rough idea is that you sensorily represent an objective sensible quality (on this view, a physical property), and are thereby aware of it, just in case you undergo an internal state (a "representation") that "registers" or "tracks" the instantiation of that property by external items." Dretske (1995) and Tye (2000) are influential proponents of this view, with Millikan (1989) cited as a more sophisticated variant. Akins (1996) targets philosophers as divergent in their opinions as Paul and Patricia Churchland, Daniel Dennett and Jerry Fodor for their shared detectionist commitment.

the ideal of perceptual veridicality as the achievement of correspondence with something in an external, perceiver-independent reality has been quietly dropped. A more considered response is to say that while "thermal perils" is a notion inextricably tied to a perceiver's interests, there is still a set of objectively measurable temperatures (and temperature changes) that constitute thermal perils (for particular animals). That set of objectively measurable temperatures can be defined in purely physical terms, without reference to biology and psychology, even though it would not be of interest to a thermal physicist. So one can still claim that thermoreceptors detect that set of temperatures, without conceding that what is detected is a perceiver-dependent property.[18]

Gerrymandered sets of physical properties, with no claim to physical significance, are held up as the objective correspondents of our perceptual states, and it has to be admitted that this eviscerates the original detectionist model whereby perceptual systems inform us about the environment just by picking up on external goings on. For the salient features of our perceptual "descriptions" cannot be considered aspects of perceiver-independent reality, but strange beasts like "thermal perils" and "cherry reds" (and the other secondary qualities). Do they cause us to suffer illusions because they get in the way of any apprehension of a perceiver-neutral world, or is the sight of a cherry red slice of pie veridical just because there is, out there, some optical stimulus which causes it, even though such stimuli have no significance in a physicist's catalogue of the world? The important lesson is that the conceptual framework which leads into this dilemma is misguided. In order to make this point clearer I will now say more about the perceptual pragmatist alternative.

4.3 Passive and Active

A distinguishing feature of the correspondence-detection model is its construal of perception as a passive, receptive process whereby external stimuli bounce onto some sensory receptors and eventually leave their trace on an inner register. Until now I have been quite non-committal about what kind of interaction could be put forward as an alternative to detection. Yet it may have been noted that the word "interaction" is not itself free of connotation. "To interact" is typically to engage in a back-and-forth with someone or something. The implication is that there are two active participants, and furthermore that activity on one side affects the other, and vice versa. So to declare that perception is an interaction is

[18]This is actually the entrenched position of contemporary colour physicalists. It is clear that the human colour visual system cannot be treated as analogous to spectrophotometer, a measuring instrument which detects SSR. This is because the sets of reflectances which humans classify as having the same colours appear in no physical description of the world. Still, the colour physicalist says, all of those reflectances which we see as cherry red are properties which belong to their objects independently of our seeing them. Thus when we see cherry red we can still be said to be detecting a perceiver-independent property of the world (Smart, 1997) (Byrne and Hilbert, 2003). See Chirimuuta (2014) for criticism of this approach to colour, and Pautz (2013) presents objections to this doctrine applied to other sensory modalities including smell and taste.

already to gesture towards a more active account.[19]

Perceptual states inform us about the environment because they are the result of interactions (the specific mechanisms of which are the topic of empirical investigation) that allow the perceiver to seek out the information needed to guide current activities.[20] The key idea—one which is, I believe, the current scientific orthodoxy—is that the perceiver must actively seek out stimuli, and that this activity necessarily shapes the resulting "descriptions". The activity of the perceiver is most striking in a modality like touch, where the exploratory gestures of the hand are obviously integral to resulting perceptual states. But this is no less the case in the seemingly passive modality of vision.

For instance the phenomenologist Hans Jonas believed that vision and touch are utterly dissimilar, writing that, "[t]ouch has to go out and seek the objects in bodily motion and through bodily contact...whereas in sight selection by focusing proceeds non-committally within the field which the total vision presents" (Jonas, 1954, 512). On his conception, vision is the distanced, contactless sense, a pure reception of information rather than an active engagement with the world. This way of understanding vision is empirically false. As it happens, we would be unable to read or view photographs if our body and eyes were static, because of the fatiguing of our photoreceptors by constant stimulation. And because of the heterogeneity of the surface of the retina, movement of the eyes (saccades) with precise gaze control is essential for normal vision [see e.g. Findlay and Gilchrist (2003), Burr and Morrone (2004)]. Recent scientific work gives credence to the idea of Merleau-Ponty (1969) that the gaze is something like a grasp. That is, we use the foveating gaze, the targeting of an object on the highest acuity region of the retina, to gain a visual handle on the thing (see, e.g. Schütz et al. (2009) on saccades and object recognition). But subjective experience has been found to be an unreliable guide to eye movement, because of the effect of saccadic suppression, the momentary impairment of vision for the duration of the saccade. So it is no wonder that the surface phenomenology of vision suggests to us that our eyes are relatively passive and immobile, even though, just as much as the sense of touch, sight relies on our active probing of the environment. As Land and Nilsson (2002, 178) summarize,"our

[19] The passive-active contrast under discussion here is not to be confused with the distinction between mental states not under any voluntary control, and those that are (i.e. vision being passive in the sense that we cannot will ourselves to see a shower of golden rain). The notion of perceptual activity outlined in this section includes any sub-personal, involuntary processing which shapes perceptual states in ways not predictable from the external stimulus. Examples under this heading are phenomena of perceptual categorisation, classification and "interpretation", as well as overt attentional modulation and bodily movement involved in perceptual exploration. For instance, when Martin (2009, 3498) writes that, "color is not a property of the objects *per se* but is a result of the brain's ability to interpret the spectral reflectance of an object, relative to the reflectance of other objects in the visual field", I take him to be emphasising the active nature of colour perception.

[20] *Enactivism* is an influential movement in recent philosophy of perception which takes perception to be a capacity that is on a continuum with an animal's ability to act in the world. Seminal works include Thompson et al. (1992), Hurley (1998) and Noë (2004). For example, Noë (2004, 17) rather controversially characterises all perceptual awareness as requiring the use of "sensory-motor knowledge." Since my task here is to articulate a minimal, naturalistic perceptual epistemology I do not endorse any such contested claims.

eyes search the surroundings for information rather than simply absorbing it". Naturally, how we search depends on what we need to do.[21]

The passive-active distinction brings us to one last question which will underscore the difference between perceptual pragmatism and its rival: "under what circumstances can perceptual states be said to be illusory?". If one assumes the passivity of perception, as presented in the detection-correspondence model, anything that the subject brings to the resulting perceptual state—any classification, omission or exaggeration of the external signal—risks being construed as a distortion, in other words, as a perceptual error or illusion. For if the perceptual process is ideally just a passive reception of external stimulation, any element in a perceptual description which fails to correspond to an external stimulus because it arises not from the stimulus, but from the perceiver's way of interacting with the stimulus (or a way of interpreting the stimulus, to employ a more metaphorical notion of activity) is of dubious epistemological standing. I will give an example to illustrate the point

In his criticism of Cohen's (2009) colour relationism, Tye (2012) brings up the example illustrated in Figure 4.1, the Adelson checker board. Citing the authority of Wikipedia, Tye calls this an illusion: the two squares A and B have an identical physical characteristic (lightness), yet we perceive them as being different shades of grey. Tye's analysis is entirely grounded in the correspondence-detection view, because it assumes from the outset that the task of the visual system is to behave like a photometer, passively noting the proportion of light reflected from each element of the image, and bringing no interpretation to bear on the resulting "description". Yet if we take perception to be active and interpretative—as it surely is—then there is nothing illusory about the way in which we perceive this image, except in the trivial way that all pictorial representations can be called "illusions" (i.e. for the fact that we interpret graphical image in ways similar to how we approach concrete scenes). To take square A to be illuminated strongly, and square B to be lying in shadow is a perfectly viable (and useful) interpretation of the image, and this naturally affects our impression of its grey levels.[22]

[21] The comparison of vision and touch is discussed at greater length in Chirimuuta (2011), and see also Chirimuuta and Paterson (2014).

[22] Tye (2012) presents the Adelson image as a counter-example to colour relationism. According to the theory of Cohen (2009) the different shades of grey we perceive the squares to have, in and out of context, would all count as genuine colours. But according to Tye, only the colours perceived out of context are the genuine ones because in that case our perception of the squares can be thought to indicate the physical identity of surfaces of A and B. In his response to Tye, Cohen (2012) does not take the line of defence I have outlined here and asserts that the relationist can still call this image an illusion, albeit one that requires a different interpretation from that of Tye. Elsewhere I argue that a relationist theory of colour does support an appearance-reality distinction in cases in which the typical functions of colour vision are disrupted Chirimuuta (2015, chap. 7).

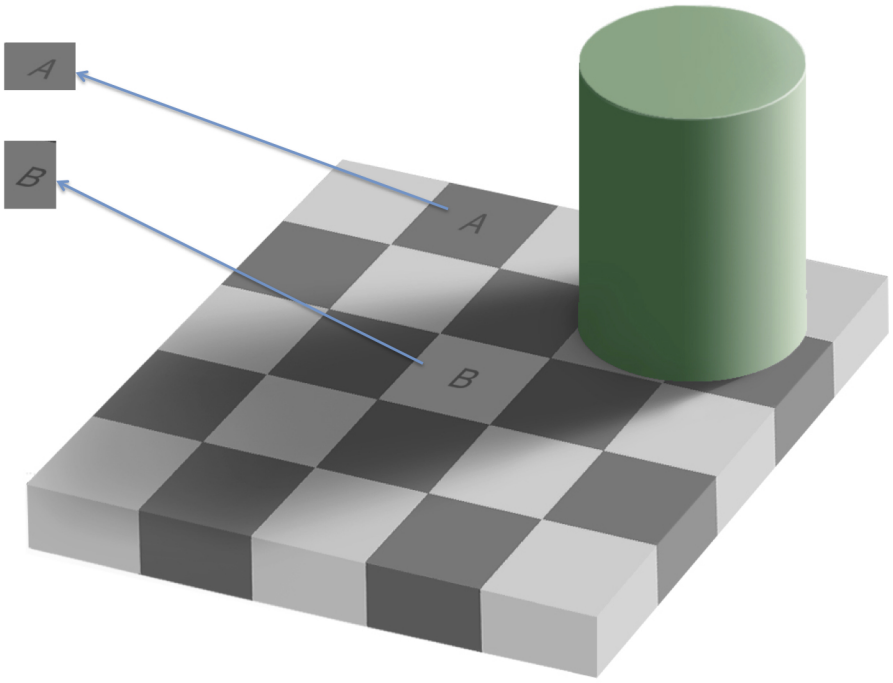

Figure 4.1: ***The Adelson Checker Shadow "Illusion"****. Squares A and B have the same physical lightness, as can be determined from the cut-outs on the left. However, in the context of the whole image, square B is interpreted as falling under shadow, and so is perceived as being made from a material which is different (a brighter shade of grey) from square A.* Image adapted from Wikimedia commons.

5 Colour Relationism is Realism Enough

To ask whether a substance or property is real is typically to ask whether its existence is mind-independent. Thus debates over the existence of time, Platonic objects, material objects and God all share a structural similarity (Dummett, 1993). The same can be said of the colour debate, as traditionally conceived. The task of this section is to show how the contrasting epistemologies of perception which were described in the previous section are connected to perceptual ontology. What will now become clear is that the traditional way of framing the debate over colour realism is bound to the detection-correspondence model of perception. The pragmatic, interaction-utility outlook allows for a reformulation of what counts as realism, and so fosters a distinctive ontological position.

According to the framework typically evoked in ontological discussions, the real world is the one consisting of objects and properties outside the mind. The unreal world is like a dream—full of stuff and qualities which are merely "in the head". "Real" is often used synonymously with "objective", meaning "out there in the world whether or not any human is around". "Inter-subjectivity" is often taken to be a good enough proxy for objectivity. If enough people agree that something is there, at least it is not a figment of one person's imagination gone awry. Dreams and hallucinations lack intersubjectivity; the sky and Mount Kilamanjaro do not, and their existence is an uncontroversial objective fact. The blueness of the sky and the beauty of the mountain, like the virtues of chivalry and vices of liberated women, are the interesting cases. They lack a full majority of subjects' endorsement, and science, often used as the ultimate arbiter of objective existence, has nothing clear-cut to say on such matters.

Now to focus on the purely perceptual, and not the aesthetic or moral qualities of objects, the ontological question is standardly one of correspondence: *which, if any, properties of objects in mind-independent reality can be said to correspond to the properties my perceptual experience presents those objects as having?* It is natural, then, to think of perceptual systems as having the role of detectors of mind-independent objects and properties. The path of influence seems also to run in the other direction. If it is assumed that perceptual systems are detecting devices then it is natural to discuss the ontological status of perceived qualities in terms of their correspondence to external, mind-independent properties. I am not in a position to claim that the reality-as-mind-independence view in ontology is more fundamental than the detection-correspondence model in the epistemology of perception, or vice versa. The important point is that they are mutually reinforcing and come as a philosophical package. If one accepts one of these views, then the other becomes practically irresistible (even if there is a position in logical space by where one can hold the detection model without the ontological framework, and vice versa).

Without the detectionist epistemology of perception and its ideal of correspondence, the ontological positions of physicalism and eliminativism both lose their motivation. Without correspondence in place as a governing metaphor, why would it seem imperative to match inner perceptual states to outer physical properties, and why would failures of correspondence count as evidence of the unreality of colour? This is the force of the perceptual pragmatist's

claim to revise colour ontology. No refutation of either physicalism or eliminativism is on offer; rather, the idea is to remove the framework according to which one is tempted to hold one or other of those positions.

On the other hand, it follows naturally from perceptual pragmatism that the subjective/objective, mind-dependent/mind-independent and appearance/reality distinctions should *not* be treated as equivalent.[23] If it is accepted that all perceptual states are the result of selective and interest-relative interactions between a perceiver and an environment, then it is unwise to think of them as representing an objective, mind-independent reality, and equally unwise to treat all of them as mere appearances, unconstrained by reality. On the perceptual pragmatist view, a different notion of realism is to be invoked. Reality is there as that which the mind bumps against, rather than that which the mind observes from a transcendent state of serene detachment.

The question for colour ontology is not whether internal colour experiences can be said to map on to colour in the external world. Instead colour perception should be examined in terms of what seeing with colour allows one to do—e.g. recognise and recall familiar items, and the numerous other functions.[24] Taking up the tool analogy often employed by the American pragmatists, there are always various ways to get the same practical result (just as there are numerous kinds of colour vision), and yet they can all be said to get us in touch with reality. There is no concession to "anything-goes" relativism because the environment constrains which tools will work, and what kinds of perceptual systems will be informative.

At this point, though, the following worry may arise: in order for perceptual pragmatism to give the relationist the resources to make the case that colours are real enough we must show that perceiving the colours themselves (as opposed to distinguishing objects) is what is useful. For it is not obvious what the payoff is in discriminating specific hues, over and above the benefit of distinguishing one object from another, recalling familiar items, etc..[25] In response I would like to point out that on the version of relationism I favour (*colour adverbialism*), colour vision is to be thought of as essentially integrated with other visual sub-modalities, such that seeing the persimmon as orange-to-me is essentially a way of perceiving its difference from the verdant foliage of the tree. So discrimination of orange from green should not be thought of as something over and above or divorced from the recognition of object versus background.[26] Other relationists may note, however, that colour categorisation furnishes us with a case in which the mere fact of being able to assign a perceived object to a perceiver-dependent hue class (e.g. seeing a persimmon as orange) helps simplify the bewildering complexity of spectral information that reaches the eye, thus making perception and action easier for cognitively limited creatures like ourselves and

[23] In other words, the point of relationism is to open up conceptual space between the real, the objective and the perceiver-independent. The polysemy of the very terms "subjectivity" and "objectivity" is a common theme authors writing on colour relationism. See e.g. Hatfield (2003) and Cohen (2010).

[24] I discuss these functions at length elsewhere [Chirimuuta (2015, chap. 4); Chirimuuta and Kingdom (2015)].

[25] I thank an anonymous reviewer for formulating this objection.

[26] In other words, colours are *ways that objects appear to me* (Chirimuuta, 2015, chap. 6).

other animals [Hardin (1992), Chirimuuta (2014)].

Of course a physicalist or eliminativist could argue that my four truisms (perception as an action-guiding interaction, the partiality of perception, etc.) are all consistent with (versions of) their theories. But note that my dialectical strategy has not been to show that either of those ontologies are inconsistent with the naturalistic and pragmatic perceptual epistemology. Rather, to return to the architectural metaphor, it has been to show that the default foundation for those other ontologies is the epistemology of correspondence, whereas relationism is the more obvious theory to build on top of pragmatist foundations. In other words, physicalism and eliminativism can be retrofit to accommodate perceptual pragmatism but we should only go to that trouble if we have independent motivations for those ontologies. I believe that without the governing idea of correspondence, both of those theories lose much of their appeal.

To conclude, the main point of this paper can be summarised quite succinctly. The debate over colour has had a governing assumption lurking in the background, namely that the reality or unreality of colour is a matter of how closely perceptual states involving colour correspond to a "God's Eye View" of the mind-independent world. This is the key thought behind both physicalist and eliminativist theories of colour, and once it is dropped both these views appear unmotivated. By replacing it with a pragmatist understanding of perceptual systems, colour relationism turns out to be the theory that is well motivated and consistent with a naturalistic picture of perception by limited creatures in real environments.[27]

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