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A Clear and Distinct Conception of Colour

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PhD 2005

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Abstract

This thesis is a defence of naïve realism about colour, the view that colours are *sui generis* mind-independent properties. The prevailing view, with its origins in early modern writers like Descartes, is that colour experience is systematically misrepresentative. I argue, in contrast, that colours are what we ordinarily think they are.

In the first part of thesis, I argue that colours are *mind-independent*: they exist independent of our experiences of colour. Acknowledging the mind-independence of colour in the first place requires being able to distinguish between colours and our colour experiences, something that we are able to do by thinking abstractly about the internal relations of similarity and difference in which colours stand. Subsequently upholding the mind-independence of colour involves resisting the Argument from Perceptual Variation. A consequence of the mind-independence of colour is that there is a sharp distinction between the colours objects really are and the objects they merely appear. The Argument from Perceptual Variation represents an attempt to undermine this appearance-reality distinction.

In the second part of the thesis, I argue that colours are *sui generis*: they are distinct from the surface reflectance properties described in physical science. Consistent with the thought that our colour experiences ‘inherit’ their phenomenology from the properties they are experiences of, colours cannot be identical with physical reflectance properties because these properties do not stand in the internal similarity relations characteristic of the colours. Instead, I argue that colours are distinct properties that supervene of metaphysical necessity on the reflectance properties of objects. Securing *sui generis* mind-independent colours a location within the natural world addresses the problem that has led philosophers since Descartes to deny that our common sense conception of colour is of itself clear and distinct.

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Acknowledgements

Some of this material has been presented at conferences in London, Oxford, Warwick, Manchester and Lund, Sweden. I would like to thank the audiences on these occasions for their comments and questions, and especially Bill Child for his commentary on an earlier version of Chapter 2. I would also like to thank the UCL Strawson Reading Group, and particularly Mathilde Jacobsen, Joel Smith, Tom Smith and Ann Whittle, for discussions about the structure of our thought about the world – and much else besides. Throughout my studies, I have been assisted in many ways by the staff and students at UCL. Special thanks, though, are due to my thesis supervisors, Tim Crane, Mark Kalderon and Mike Martin. Without their countless explanations, probing objections, invaluable suggestions and constant encouragement, this work would not have been the work that it is. Tim deserves special mention for making sure that the work was finished on time; Mark for helping me to focus during the difficult middle stages of the project; and Mike for setting me off in the right direction in the first place. Without Mike, this would have been a very different thesis indeed; I might even have had the misfortune of being an eliminativist!

On a more personal level, I would like to thank my parents and sister, for their unfailing support throughout this long undertaking, and Anna, for making it all worthwhile. I would also like to gratefully acknowledge the financial assistance that I have received from the Arts and Humanities Research Board and the Royal Institute of Philosophy.

Introduction

A Painter or Dyer, who never enquired into their causes, hath the *Ideas* of White and Black, and other Colours, as clearly, perfectly, and distinctly in his Understanding, and perhaps more distinctly, than the Philosopher, who hath busied himself in considering their Natures.

Locke 1690: II.viii.3.

The bold claim of this thesis is that *colours are what we ordinarily think they are*.

Although this claim may not sound especially bold, the contrary view that our ordinary thought about colour is systematically mistaken has a very long, very distinguished history, and is by far the most widely held view amongst scientists and philosophers to this day.

Ordinary thought is generally believed to go wrong in one of three ways. According to *eliminativists*, the colours we ordinarily suppose material objects to instantiate do not correspond to any properties that material objects actually possess. Eliminativism is the most extreme form of error theory. *Relationists* at least think that material objects are coloured. But they generally claim that ordinary thought misclassifies colours, mistaking merely mind-dependent relations between subjects, objects and environmental conditions for non-relational mind-independent properties. Finally, *physicalists* claim that material objects are coloured, often that colours are non-relational mind-independent properties, but that our naïve conception of colour is nevertheless deficient because it is essentially incomplete. According to the physicalist, colours are properties whose essential nature is hidden from view, and it is the physicist's job to uncover what this nature consists in.

The view that common sense is systematically mistaken with respect to colour crystallises in the modern period in the work of Descartes. According to Descartes, when:

someone says he sees colour in a body...this amounts to saying that he sees...something there of which he is wholly ignorant, or, in other words that he does not know what he is seeing.¹

It is not always entirely clear quite which error thesis Descartes meant to endorse. Descartes's considered opinion, at least in the most complete expression of his scientific system, the *Principles of Philosophy*, appears to be just that colours are

¹ 1644: I.68.

physical properties whose essential nature is not revealed in sensory perception: they are, for example, certain configurations of particles. Whatever the details, though, the striking idea that subsequently became common place is that we might be systematically mistaken in our ordinary beliefs about colour: as Descartes himself would put it, that we ordinarily lack a *clear and distinct conception of colour*.²

Since Descartes's time, each of the three types of error theory has had its champions. The case for eliminativism, for instance, was initially taken up with vigour by the Cartesian Malebranche, who claimed that in judging of material objects that they are coloured, the soul "spread[s] itself onto the objects it considers by clothing them with what it has stripped from itself".³ Something like this view tends to be the standard view amongst modern scientists: the renowned vision scientist Zeki is fairly representative when he claims that colour is "a property of the brain, a property with which it invests the surfaces outside".⁴ Hardin's cross-pollination of scientific and philosophical ideas, however, has recently revived interest in this view in the philosophical community.⁵

Still, amongst philosophers, physicalism about colour tends to be a more popular view. Physicalists vary depending upon which physical properties they identify colours with. One version of physicalism identifies colours with the properties of objects to reflect, or otherwise modify, light in a characteristic manner. An alternative view, particularly popular in Australia, identifies colours instead with the microphysical properties of objects in virtue of which they modify light in this way.⁶

Partly as a result of this disagreement, physicalists differ in quite how incomplete they take our ordinary conception of colour to be. The view inspired by Descartes is that visual experience leaves the nature of colour wholly open. As Reid puts it, colour involves "an unknown cause, and a known effect...as the cause is unknown, we can form no distinct conception of it, but by its relation to the known

² In Descartes's lifetime, Galileo had already suggested that "tastes, odours, colours, and so on are no more than mere names so far as the object in which we place them is concerned...they reside only in consciousness", 1623: 274. The general view is, of course, much older, and stretches back to early Greek atomists such as Democritus.

³ 1674-5: 58.

⁴ Zeki 1993: 236. Compare Hering 1920: 2-3, Kaiser and Boynton 1996: 33, Palmer 1999a: 95.

⁵ Hardin 1988. Recent eliminativists include Jackson 1977 and Boghossian and Velleman 1989.

⁶ Reflectance-physicalists include Hilbert 1987, Byrne and Hilbert 1997 and 2003, Hilbert and Kalderon 2000, Tye 2000. Proponents of the Australian 'primary quality view of colour' include Armstrong 1968, Smart 1975 and Jackson 1998. Physicalism is discussed in Chapter 6.

effect”.⁷ According to this way of thinking, there is a very fine line between realism and eliminativism. If colours lack any intelligible relation to our colour experiences then it can seem like little more than a metaphysical nicety to call this view realist at all. As Malebranche notes, there may be a sense in which grass is green if by colour you mean:

such and such a movement of insensible parts...But if by heat and the other qualities you mean what I feel near fire, what I see when I see grass, and so forth, then fire is not hot at all, nor is grass green.⁸

Accordingly, many contemporary physicalists prefer to localise the error they attribute to common sense, claiming that colours at least have those properties that we ordinarily perceive them to: for instance, that they stand in the relations of similarity and difference characteristic of the colours. Either way, physicalists agree at least that the essential nature of colour is hidden from view, and that to suppose otherwise is to commit what Hilbert has called “the fallacy of total information”.⁹

Probably the most popular view amongst philosophers, however, is still the secondary quality view of colour that comes via Locke. Whereas Descartes identifies colours with the properties that he thinks physical science will eventually tell us cause our colour experiences, Locke is generally more circumspect, identifying colours instead just with the dispositions, or powers, of objects to appear a certain way. Locke’s motivation for this is to secure the “adequacy” of our simple ideas – their agreement with “the reality of Things” – even in the eventuality that there are no configurations of particles (“corpuscular textures”) to which particular sensations of colour correspond.¹⁰ According to this view, the relevant dispositions are distinct from the corpuscular textures, or physical properties more generally, in virtue of which objects have these dispositions. In effect, dispositionalism about colour is therefore a version of what in the philosophy of mind is called ‘role-functionalism’. Role-functionalism identifies mental states with second-order properties defined by certain characteristic patterns of behaviour that their bearers exhibit. The traditional motivation for this view is also to avoid problems about multiple-realisation: cases in

⁷ 1764: VI.4, p86.

⁸ 1674-5: 441.

⁹ 1987: 37.

¹⁰ Locke explains: “if Sugar produce in us the *Ideas*, which we call Whiteness, and Sweetness, we are sure there is a power in Sugar to produce those *Ideas* in our Minds, or else they could not have been produced by it”, 1690: II.xxxi.2.

which there is no unique first-order physical property common to all the objects that exhibit the behaviour characteristic of the second-order functional property.¹¹

Different dispositionalists and role-functionalists disagree depending upon precisely how they individuate colours. The standard view, following Locke, identifies colours as dispositions to produce in us certain kinds of experience; quite how you understand ‘experience’ itself depending on your general view of perception. Colours do not, however, need to be identified with dispositions to produce anything internal to the mind: appearances can instead be properties of material objects (‘appearance properties’).¹² Indeed, objects can be disposed to appear a certain way without there being any ‘appearances’ at all. As Cook Wilson explains, to suppose otherwise may involve an illegitimate reification of ‘appearance’:

for the true appearance (=appearing) to us of the *object* is substituted, through the ‘objectification’ of the appearing as appearance, the appearing to us of an *appearance*.¹³

Whichever way colours are ultimately individuated, the umbrella term *relationism* brings out the intimate relationship that colours bear to perceiving subjects and conditions of perception according to this general way of thinking. To say that colours are the properties of objects to appear a certain way presupposes that there is a certain set of perceivers, and a certain set of viewing conditions, to which, and in which, they so appear: what appears one way to one perceiver in one set of conditions may appear different to different perceivers in the same conditions, or to the same perceiver in different conditions. This individuation of colours in terms of perceiving subjects and environmental conditions means that a difference in either entails a difference in colour. Colours, according to these views, are therefore *mind-dependent* properties.¹⁴

¹¹ Putnam 1975. Recent dispositionalists about colour include Mackie 1976, Peacocke 1983, McGinn 1983, Johnston 1992 and Wright 1992.

¹² McDowell, for instance, identifies redness as an object’s disposition “to present a certain sort of perceptual appearance”, stressing that there is no general obstacle to taking at face value the appearance that secondary quality perception “presents itself as perceptual awareness of properties genuinely possessed by the objects that confront one”, 1985: 112. A similar idea is implicit in Evans 1980.

¹³ 1904: 796; compare Pritchard 1909: 73-6.

¹⁴ Relationism is in general also consistent with physicalism, if the disposition to appear a certain way (to a certain observer in certain circumstances) is identified with the physical grounds of this disposition, and not the disposition itself. See, for example, Jackson and Pargetter 1987, Averill 1992 and McLaughlin 2003.

This is not to say that according to the relationist there need be no sense in which colours can be thought to persist in the absence of their constituent relata. The relationist can allow that an object can be such as to appear yellow without actually appearing yellow on any particular occasion, because there are no suitably placed perceivers of the right kind or the necessary environmental conditions do not obtain. Indeed, if the relationist rigidifies the description of the relevant perceivers and environmental conditions to normal perceivers and normal viewing conditions as they are in the actual world, then objects can be such as to appear yellow even if there are no perceivers of the right kind or the relevant viewing conditions never obtain.¹⁵

But it is important to be clear about exactly what this amounts to. All the relationist is saying is that in the absence of the necessary conditions obtaining certain counterfactual conditionals are true: yellow objects *would* appear a certain way were the relevant conditions satisfied. What they are *not* saying is that the truth of these counterfactuals is grounded in any further facts about the colours of objects. This is the idea that relationists variously express by saying that an object's colour is 'nothing over and above' its being such as to appear a certain way, that it 'consists in' being such as to appear a certain way, that is 'just is' its being such as to so appear.¹⁶ What grounds the disposition of an object to appear a certain way – that in virtue of which the associated counterfactual conditionals are true – is the object's being a certain way physically; it is because the object has certain physical, non-colour, properties that it is such as to appear, for example, yellow.

The important point is that according to relationists colours are not *of themselves* mind-independent properties. They are there to be perceived only in the derivative sense that the primary qualities on which they depend persist in the absence of their perception. The bottom line difference between relationist views according to which colours are relations that exist only in the actual presence of their relata, and relationist views according to which colours exist where the conditions necessary for their perception do not, is therefore minimal. If relational colours are genuinely distinct from their physical grounds, then there is a clear sense in which they do not *really* exist in the absence of their appearing a certain way at all.

¹⁵ See, for instance, Peacocke 1983, McDowell 1985, Wright 1992: 113-4.

¹⁶ For examples of these locutions, see Evans 1980: 272, fn. 27, McGinn 1983: 6, Cohen 2005.

As Boyle points out, their manner of existence in these circumstances is fundamentally different to their manner of existence in the favourable circumstances in which object, subject and environmental conditions co-occur:

if there were no sensitive beings, those bodies that are now the objects of our sense would be but *dispositively*, if I may so speak, endowed with colours, tastes, and the like, and *actually* but only with those more catholic affections of bodies – figure, motion, texture, &c.¹⁷

Following Locke, relationism is usually presented as an error theory: the claim that colours are mind-dependent dispositions of objects to appear a certain way is offered as a corrective to the common sense view that colours are mind-independent properties. With the worries that motivate the ascription of error to ordinary thought in the background, however, an interesting variation on the relationist position presents relationism, not as an error theory, but as the view of colour implicit in common sense all along. According to this view, the conception of colour usually attributed to common sense isn't even intelligible: we cannot even understand what it would be for colours to be of themselves mind-independent properties. It therefore represents, as McDowell puts it, a "gratuitous slur" on common sense to suppose that this is what we ordinarily take colours to be.¹⁸

All this leaves us in a rather unenviable position. On the one hand, it is widely believed that colours are not what we ordinarily think they are. On the other hand, there are those who question whether what is ordinarily thought to be the common sense view of colour is really what we ordinarily think colours are at all. How did we get into this mess? And more importantly, how do we get out of it?

In trying to answering these questions, the thesis is organised around two main contrasts: between mind-dependent and mind-independent views of colour in the first part, and between physicalist and *sui generis* views of colour thereafter. After setting out in more detail the Cartesian background to the problem in Chapter 1, Chapters 2-5 are concerned with the mind-independence of colour. In Chapter 2, I

¹⁷ 1666: 25.

¹⁸ McDowell 1985: 113; see Chapter 2. There are at least some writers who claim both that we ordinarily think of colours as mind-independent properties and that our common sense conception of colour is neither systematically mistaken nor essentially incomplete in this respect. Campbell 1993 is perhaps the best recent example, although similar views can be found in Yablo 1995 and Watkins 2003. Intermediate between this position and that of the physicalist are Westphal 1987 and Broackes 1992, who identify colours with 'ways of changing the light', but ways of changing the light that make ineliminable reference to how the light they change looks. Sympathetic to the naïve position is Stroud 2000, who argues that our common sense beliefs about colour are at least immune to critical scrutiny (see §3.1).

argue that the view of colour implicit in common sense is that colours are mind-independent properties. The subsequent Chapters then defend the common sense view of colour in response to the Argument from Perceptual Variation. In Chapter 6 I argue against the physicalist that colours are *sui generis* properties: they are distinct from the properties described in physical science. This leaves in Chapter 7 the problem which led Descartes to reject the mind-independence of colour in the first place: the problem of locating *sui generis* mind-independent colours within the natural world. I argue that colours supervene of metaphysical necessity on an object's physical properties, and that this secures their genuine mind-independent existence. Insofar as colours are mind-independent *sui generis* properties, I suggest that our common sense conception of colour is after all clear and distinct.

[1] Mechanism, Resemblance and Secondary Qualities

The *Democritick* and *Epicurean Atheists*...acknowledge no other *Modes of Matter* or *Body*, but only more or less *Magnitude of Parts, Figure, Site, Motion*, or *Rest*. And upon this very account do they explode *Qualities*, considered as *Entities* really distinct from these *Modes*; because, in the *Generation* and *Alteration* of them, there would be *Real Entities* made *Out of Nothing*, or *without a Cause*; whereupon they Resolve these *Qualities* into *Mechanism* and *Fancy*.

Cudworth 1678: 755.

Although it is widely known that Descartes viewed the deliverances of colour experience with suspicion, the bearing of this on Locke's famous distinction between *primary qualities*, like shape, size and texture, and *secondary qualities*, like colour, taste and sound, is not much discussed. To the near exclusion of all other seventeenth century mechanists, it is Boyle who dominates discussions of the background to Locke's distinction. This is rather surprising. In the first place, Boyle's "corpuscularian theory of matter" is supposed to be neutral on the points of doctrine that differentiate broadly mechanistic theories of matter. Being "a person of a reconciling disposition", Boyle prefers to regard theories which explicate natural phenomena mechanistically by way of minute bodies, or corpuscles, as "one philosophy".¹ Acknowledging Boyle's influence on Locke is therefore consistent with recognising the influence on Locke of corpuscularians other than Boyle. Descartes's influence is anyway well-documented. During his time as an undergraduate at Oxford, for instance, Locke made detailed notes on the most complete statement of Descartes's mechanistic science, *The Principles of Philosophy*.² The experience was obviously beneficial, as in response to Edward Clarke's request that Locke suggest reading for his son, Locke recommended Descartes's scientific theory as "perhaps the most intelligible and most consistent with it self of any yet met with".³

This Chapter sets Locke's famous primary-secondary quality distinction against its Cartesian background. §1.1 reconstructs Descartes's argument for the

¹ 1661: 356.

² For details, see Milton 1994.

³ de Beer 1976 ii: no. 844. The letter, sent 5/15th March 1686, dates from around the period that Locke is thought to have completed the final draft of the *Essay Concerning Human Understanding* – Draft C – suggesting that Descartes was fresh in Locke's mind at the time. Locke repeated his recommendation, in a slightly revised form, subsequent to the publication of the *Essay* (1693b: §193).

distinction between mechanical modifications and sensible qualities. §1.2 sets out Locke's very similar argument for the very similar distinction between primary and secondary qualities. The comparison is used, in §1.3, to offer an interpretation of the claim that only our ideas of primary qualities "resemble" qualities of material bodies. §1.4 considers the response of two contemporary critics of mechanism, Margaret Cavendish and George Berkeley, whilst §1.5 assesses the relative strengths and weakness of the two versions of the argument. I argue that the Cartesian bifurcation of the mental into distinct sensory and intellectual faculties gives Descartes the resources to guarantee the validity of the argument for the primary-secondary quality distinction, but makes accounting for the phenomenology of sensory perception notoriously difficult. In rejecting this bifurcation, Locke's version of the Cartesian argument is therefore both deductively invalid, and yet able to respect the phenomenology of secondary quality perception in a way that Descartes's cannot.

1. Mechanism: Descartes

Descartes's argument for the distinction between mechanical modifications like size, shape and motion, and sensible accidents like colour, taste and sound, is an essentially *a priori* argument, fundamental to which is our conception of material substance and the constraints on conceivable bodily interaction that our conception of material substance sets.

According to Descartes, the "principle property" of material substance, without which material substance is simply unintelligible, is extension.⁴ A substance's principle property differs from its modifications to the extent that we can clearly conceive *in general* of the substance in which a mode inheres independently of that modification. Nevertheless, at least in the case of *particular* material substances the distinction between modification and principle attribute collapses, insofar as we could neither sensorily perceive, nor conceive of sensorily perceiving, a particular material body that lacked the various modifications of which extended substances

⁴ 1644: I.53.

are capable: determinate extensions, shapes and positions and motions of their parts.⁵

Modes contrast in this respect with a substance's accidental qualities, which can be "removed" from corporeal matter "while the matter itself remains intact".⁶ Descartes gives two criteria by which to determine whether or not a quality is accidental. According to the *empirical criterion*, it is sufficient for a quality to be accidental that we have actually perceived a body that lacks it. Sensible qualities like colour are therefore merely accidental properties because we have actually seen, for example, stones "so transparent as to lack colour". According to the more stringent *conceptual criterion*, a quality is accidental if we can merely conceive of a body lacking it. Hardness is therefore accidental because we can at least conceive of a melted or pulverised stone that lacks hardness.⁷ No less accidental by this criterion is impenetrability which, as Descartes explains elsewhere, "involve[s] a reference to parts and presuppose[s] a continuous body of division or limitation": so, for example, we can conceive of an indefinite continuous body in which there is nothing except extension.⁸

This combination of empirical and conceptual consideration determines which modifications constitute our conception of particular material substance. In turn, our conception of particular material substance determines our conception of intelligible bodily interaction. Specifically, from the fact that we conceive of material substances as extended, shaped bodies whose parts have position and motion, it follows that the only way in which we can conceive of material substances acting upon each other is by affecting the extension, shape, position and motion of the parts of the material substances with which they come into contact.

This inference from our conception of bodily substance to our conception of bodily interaction is underwritten by a *causal likeness principle*, which imposes a 'proportionality' constraint on the intelligibility of the causal relation: in general that

⁵ 1644: I.64-5. Indeed, elsewhere *modal* distinctions, between modes and substances and different modes of the same substance, and *conceptual* distinctions, between a substance and its principle property, are simply treated as species of the same distinction; 1641, *First Replies*: 85-6 and Descartes to *** 1645/6, CSMK: 280.

⁶ 1644: II.4.

⁷ 1644: II.11. More prosaically, although less convincingly, we can conceive that, "[i]f, whenever our hands moved in a different direction, all the bodies in that area were to move away at the same speed as that of our approaching hands, we should never have any sensation of hardness"; 1644: II.4.

⁸ Descartes to More 5th February 1649, CSMK: 361.

nothing comes from nothing, but more specifically, that what is more perfect is not produced by what is less perfect.⁹ In particular, this principle renders unintelligible Scholastic explanations of everything from transubstantiation to secondary quality perception in terms of “real” qualities. In contrast to inseparable modifications such as shape, real qualities are supposedly capable of being separated from, and existing independently of, material substances. Notwithstanding the conceptual confusion involved in predicating of qualities the exclusively substantial attribute of capacity for independent existence, to suppose that the inseparable mechanical modifications of bodies could ever produce a quality that is separable from material substance would be to suppose that something incapable of independent existence could have a causal influence on that which is capable of independent existence. In other words, it would be to suppose that what is less perfect could have a causal influence on what is more perfect. Because as this violates what Descartes regards as the intuitively (demonstratively) certain *causal likeness principle*, it follows that the Scholastics, who treat change in a body’s supposedly real qualities as a kind of motion, succeed only in “making the nature of motion less intelligible to themselves”. Instead, the only way in which we can intelligibly conceive of material substances acting upon each other is by virtue of “local motion”.¹⁰

Ironically, with exactly what Descartes intended to replace the unintelligible general Scholastic conception of motion is itself far from clear. Descartes’s official view is that motion and rest are modifications of material substance, and so cannot pass from one body to another: to suppose otherwise would require that rest and motion are precisely the kind of separable quality whose existence Descartes is at pains to deny. Nevertheless, there is a clear tension between Descartes’s essentially static official conception of motion and the view of motion that is apparently presupposed by his third law of nature. Governing bodily interaction, a very natural

⁹ 1644: I.18.

¹⁰ 1644: I.69. Descartes tells us that “the principal argument which induced philosophers to posit real accidents was that they thought that sense-perception could not be explained without them”; 1641, *Sixth Replies*: 293. Especially important, though by no means the sole motivation, is the explanation of the sensory perception of the bread and wine that according to Catholic doctrine is literally transformed into the body and blood of Christ during the Eucharist; see 1641, *Sixth Objections*: 281. Elsewhere, Descartes suggests that Scholastic philosophers also use real qualities to explain bodily motion; see Descartes to Mersenne, 26th April 1643, CSMK: 216. For helpful discussions of real qualities, see Anstey 2000: 94-9 and Rozemond 1998: 102-38.

interpretation of this law is that stronger bodies literally “lose” a quantity of motion equal to that which they “impart” to weaker bodies on collision.¹¹

Whatever the correct interpretation of Descartes’s conception of motion, it is incumbent on Descartes to explain our sensory perception of material substances in a way consistent with the claim that our only intelligible conception of bodily interaction is ‘impulsive’. Central to Descartes’s explanation of sense-perception in the *Principles* – itself heavily reliant on his earlier account of sense-perception in the *Dioptrics* – is a corpuscular theory of light in which light is described by analogy with imperceptible tennis balls reflected and refracted by objects on collision.¹² Taking this analogy at face value, sensory perception occurs when imperceptible spherical bodies travel between material bodies and the eye, pass through the fluids and transparent membranes of the eye, thereby strike the retina and form an image. These images subsequently set into motion optic-nerve fibres, different motions of which cause different sensations in the soul.¹³ The result is an idea in the mind that represents, by “resemblance”, the particular mechanical modifications of material objects:

as a result of sensory stimulation, we have a clear and distinct perception of, some kind of matter, which is extended in length, breadth, depth, and has various differently shaped and variously moving parts...and we appear to see clearly that the idea of it comes to us from things located outside ourselves, which it *wholly resembles*.¹⁴

The claim that our ideas of the mechanical modifications of material substance “resemble” those modes draws a *conceptual distinction* between a body’s mechanical

¹¹ 1644: II.40. This criticism is made by Henry More; see Descartes to More, August 1649, CSMK: 382. Looking ahead, it is worth noting More’s influence on Locke. Locke’s library contained at least 6 of More’s own works (Harrison and Laslett 1965: 2043-2047a), and Locke was well acquainted with More’s criticisms of Cartesian philosophy. With specific reference to More’s *Enchiridion Metaphysicum* of 1671, for example, Locke wrote in his journal for 22nd January 1687, that More “wrote subtly and knowledgeably against Descartes’s system” (for details, see Bonno 1955: 164).

¹² 1637: II, CSM i 156-64. In his unpublished work Descartes is less circumspect, avoiding the atomistic connotations of this analogy. In the posthumously published *The World or Treatise on Light*, for instance, Descartes characterises light instead as the instantaneous communication of a tendency to motion through pressure exerted on globules of the second element by celestial matter. It is worth noting that in a letter to Vatier, Descartes claims that *The World* contains “the whole body” of his physical theory; 22nd February, 1638, CSMK: 87.

¹³ 1644: IV.189-95; 1637: IV. As Descartes explains elsewhere, the motion in the optic nerve fibres causes sensations by way of images traced in the spirits on the surface of the pineal gland. See, for example, the *Treatise on Man*, posthumously published in 1664, CSM i: 106.

¹⁴ 1644: II.1, emphasis added. In a slightly earlier passage, Descartes expresses the same thought by saying that the mechanical modifications shape, size, position and motion of parts are “actually or at least possibly present in objects in a way *exactly corresponding* to our sensory perception or understanding”, 1644: I.70, emphasis added.

modifications and its supposedly sensible qualities. Descartes illustrates this contrast by analogy with the experience of pain. We do not assume that pain is a quality of the objects which cause painful sensations that in any way resembles those sensations: the sensation of pain that ensues from being struck by a sword, for example, “is completely different from the local motion of the sword or of the body that is cut”.¹⁵ But why suppose the situation is any different with respect to sensible qualities like colour, sound, smell and taste? According to Descartes, it is not. Setting aside preconceived opinions formed in early childhood as a result of the necessarily close tie between mind and body, Descartes argues that we can no more “find any intelligible resemblance” between qualities of objects and sensations of colour than we can between qualities of objects and sensations of pain.¹⁶

Suppose, for the purposes of *reductio*, that our sensations did resemble modifications of material substance. We would then first have to explain the production of these sensible qualities purely in terms of the action of an object’s mechanical modifications; we would have to explain, that is, how an object’s sensible qualities could be consequent upon its instantiating purely mechanical modifications. We would also have to explain how these sensible qualities could in turn cause alterations in the purely mechanical modifications of other bodies, given that the proximate causes of our secondary quality sensations are motions in the brain: something attested to, Descartes claims, by sensory experiences in which sparks of flashing light are experienced as a result of striking the retina and thereby communicating motion along the optic-nerve fibres to the brain. According to Descartes, however, neither would-be explanation is intelligible:

there is no way of understanding how...size, shape and motion can produce something else [*sc.* real qualities or Scholastic forms] whose nature is quite different from their own...and we cannot understand how these qualities or forms could have the power subsequently to produce local motions in other bodies.¹⁷

That is, we cannot understand secondary quality perception except in mechanistic terms. To suppose, for example, that colour perception is the result of real qualities literally separating themselves from material substances, ‘flitting’ through the air to the eye, and then being transmitted from eye to the mind, would violate the *causal*

¹⁵ 1644: IV.197.

¹⁶ 1644: I.66-71.

¹⁷ 1644: IV.198.

likeness principle which requires that causes be proportional to their effects. There is therefore a *metaphysical distinction* between mechanical modifications and sensible accidents. In contrast to shape, size and motion, sensible qualities like colour are not really qualities at all: they are “nothing else in the objects...but certain dispositions depending on size, shape and motion”.¹⁸

2. Mechanism: Locke

Before assessing the bearing of this on Locke’s argument for the more famous primary-secondary quality distinction, we first need to identify Locke’s argument. It is commonly assumed that Locke’s argument for the primary-secondary quality distinction is located primarily between II.viii.16-21, with the well-known discussions of the fire, manna, porphyry, almond and water. Indeed, in her comprehensive review of the secondary literature on this subject, Margaret Wilson describes sections II.viii.19-21 in particular as constituting “a sort of watershed in historical interpretation”.¹⁹

But this is not in fact where Locke’s argument for the primary-secondary quality distinction is primarily located. We can see this by considering just the structure of Locke’s discussion. According to the marginal summaries added to the Second Edition of the *Essay* in 1694, II.viii.15-23 (II.viii.15-22 in the Fourth Edition of 1700) form a unified whole. The most natural interpretation of this is that 16-21, the sections in which Locke’s arguments for the primary-secondary quality distinction are usually thought to lie, serve to elucidate the claim made at II.viii.15, that only our ideas of primary qualities are resemblances. Locke describes the resemblance claim of section 15, however, as an observation that is “easie to draw” from II.viii.14, itself a statement of the primary-secondary quality distinction drawn on the basis of the discussion of II.viii.9-13. The resemblance claim of section 15, which sections 16-21 serve to elucidate, is therefore most naturally understood as a corollary of the discussion of sections 9-14. In which case, sections 16-21 must serve merely to elucidate and clarify the conclusion that has *already* been established by II.viii.15.

¹⁸ 1644: IV.199.

¹⁹ 1992: 212.

This appearance is borne out if we compare the discussion of the primary-secondary quality distinction in the *Essay* with the earlier discussions in the ‘Epitome’, published two years before the *Essay* in 1688, and *Draft C* of the *Essay*, thought to be written around a further two years before that. Neither discussion contains anything that corresponds to the sections in which Locke’s argument for the primary-secondary quality distinction is traditionally thought to lie. Rather, that from which Locke draws the primary-secondary quality distinction follows very closely the text of II.viii.9-15 of the First Edition of the *Essay*.²⁰

Matters are complicated at this point by revisions that Locke made to sections 9-15 for the Fourth Edition of the *Essay*, published in 1700, the text on which modern editions of the *Essay* are based. However, if we follow the text of the first three Editions of the *Essay*, in which the definition of secondary qualities at II.viii.10 is absent and the interaction principle of II.viii.11 is stated in its unrevised form, it soon becomes apparent that Locke’s argument for the primary-secondary quality distinction is actually just an extremely succinct expression of Descartes’s *a priori* argument for the distinction between mechanical modifications and sensible qualities. Indeed, this would seem to be precisely the kind of “speculative Truth” the discovery of which Locke cites in the First Edition of the *Essay* as a paradigmatically pleasurable experience.²¹ Schematically, the argument of II.viii.9-15 in the first three Editions of the *Essay* runs as follows:

9. The primary qualities of bodies are solidity, extension, motion or rest, number and figure.

10. Such qualities are:

- [1] “wholly inseparable from the Body”;
- [2] “such as in all the alterations and changes it suffers...it constantly keeps”;
- [3] “such as Sense constantly finds in every particle of Matter, which has bulk enough to be perceived”;
- [4] inseparable in thought “from every particle of matter, though less than to make it self singly be perceived by our Senses”.

11. The only way in which we can conceive of bodies operating on each other is by *impulse*: it is “impossible to conceive, that Body should operate on what it does not touch...or when it does not touch, operate any other way than by Motion”.

12. Since the objects of perception can only operate on contact and are not “united” to our minds, “’tis evident some singly imperceptible Bodies must come from them to the Eyes, and thereby convey to the Brain some *Motion*, which produces these *Ideas* we have of them in us”.

²⁰ For more details, see Hill Forthcoming and Walmsley 2003.

²¹ E II.xx.18. This example does not occur in any subsequent edition.

13. By analogy with pain, we can conceive that the same is true of secondary qualities: “it being no more impossible, to conceive, that God should annex such *Ideas* to such Motions, with which they have no similitude; than that he should annex the *Idea* of Pain to the motion of a piece of Steel dividing our Flesh, with which that *Idea* hath no resemblance”.

14. Therefore, secondary qualities “are in truth nothing in the Objects themselves, but Powers to produce various Sensations in us, and *depend on those primary Qualities*”.

15. “From whence I think it is easie to draw this Observation, That the *Ideas of primary Qualities* of Bodies, are *Resemblances* of them...but the *Ideas, produced* in us *by these Secondary Qualities, have no resemblance* of them at all”.

The argument works in exactly the same way as Descartes’s. Primary qualities are, by definition, [1] inseparable from bodies and – what may be understood as an explication of the technical term ‘inseparability’ – [2] in bodies regardless of what changes or alterations those bodies undergo. As such, the list of primary qualities includes solidity, extension, figure, number and motion or rest.²²

There are two criteria by which to determine whether or not a determinable quality satisfies the characteristics definitional of primary qualities. Applying only to bodies big enough to be perceived, the *empirical criterion* [3] disqualifies a property from primary quality status if we have ever actually perceived a body that lacks it. Locke suggests elsewhere in the *Essay* that colours fail to satisfy this criterion for primary quality status as there are objects like diamonds, or, when viewed under a microscope, sand, pounded glass, and the liquor in which red globules found in the blood swim, that we know to be pellucid.²³ However, even if we had never actually seen a body so pellucid as to lack colour, colours would still fail to qualify as primary qualities so long as they failed the second, *conceptual criterion* [4], for primary quality status. The *conceptual criterion* extends the empirical *epistemic criterion* first, to those macroscopic bodies that as a matter of fact we have never actually perceived, and more importantly, to the “good store of bodies” which are too small to perhaps ever be perceived, but which are fundamental to mechanistic explanations of the interaction of macroscopic material bodies.

Consider, by way of illustration, solidity, the inclusion of which on Locke’s list of primary qualities marks an important theoretical disagreement between Locke and

²² Number is not constant in Locke’s primary quality lists. Similarly variable is texture, which in the First Edition is first mentioned in II.viii.14, does not feature on the subsequent lists of II.viii.15, 16 or 17, and reappears again only in II.viii.18.

²³ II.xxiii.11.

Descartes. Solidity satisfies the epistemic criterion for primary quality status because Locke thinks that we receive no idea more constantly from sensation than solidity. At the same time, it also passes the conceptual test for primary qualities because if the mind, having got the idea of solidity from macroscopic bodies, “traces it further...to the minuest Particle of Matter”, it will find that solidity is “inseparably inherent in Body, where-ever, or however modified”. In other words we cannot conceive of a body that lacks solidity.²⁴

The qualities identified as primary in II.viii.9, via the procedure described in II.viii.10, constitute our conception of material substance. As such, they ground the inference to the impulsive action principle of II.viii.11, insofar as our conception of bodily interaction is determined by what we take bodies to be. For instance, from the fact that nothing in our conception of material substances explains how bodies could interact when not touching, it follows that we cannot conceive of bodily action at a distance. Instead, the only way in which we can conceive of solid, extended, figured, mobile material bodies operating on other such bodies is by impulse, something which we can intelligibly conceive of occurring only on the occasion of their contact; like when one billiard ball communicates its motion to another.

As for Descartes, Locke’s inference from bodily constitution to bodily interaction is underwritten by a commitment to intuitively (demonstratively) certain *causal likeness principles*: first, that from nothing can come nothing, and second, the specific version of this principle, that there must be at least as much “perfection” in the cause as there is in the effect.²⁵ These principles impose the constraint on the intelligibility of the causal relation that the cause be an entity of the right type to bring about the effect. As such, they rule out the possibility that the primary qualities of bodies produce qualities that differ fundamentally in kind to themselves; specifically, that primary qualities, which by definition [1] are *inseparable* from bodies, produce distinct *separable* qualities.²⁶ To suppose, like the Scholastics, that the inseparable primary qualities of bodies could ever produce a quality that is separable

²⁴ II.iv.1.

²⁵ See IV.x.3 and 10 respectively. That Locke’s argument for the primary-secondary quality distinction is supposed to be deductive is suggested by the analogy that he draws at IV.x.3 between the causal likeness principle – that nothing can come from nothing – and the proposition that nothing is not equal to two right angles, without which the paradigmatic deductive science, Euclidean geometry, would be impossible.

²⁶ Note, however, that in a departure from Scholastic terminology, Locke reserves the term “real” for the *inseparable* primary qualities of bodies, II.viii.17.

from material substance would be to suppose that what is less perfect could produce what is more perfect. It would also frustrate any pretensions that we might have of deducing *a priori* facts about the nature of bodily interaction from facts about bodily constitution. *A priori* deducibility requires universality: that the effects of a body's primary qualities be always and everywhere the same. To guarantee this, inseparable primary qualities need to only ever produce changes in inseparable primary qualities.

Consistent with the impulsive action claim of II.viii.11, section 12 offers an account of how we perceive the primary qualities of material bodies. According to Locke, perception occurs when material bodies interact with the sense organs by way of imperceptible particles that communicate motion from these objects to perceiving subjects. This motion is subsequently transmitted from the sense organs to the brain, and thereby excites in our minds primary quality ideas. Although Locke is more circumspect than Descartes in explaining exactly how motions in the brain are able to excite in our minds these ideas, the general similarities of Locke's account to the Cartesian theory of sense-perception are striking. Indeed, in one of the few explicit references to any other philosopher in the *Essay*, Locke elsewhere even parodies Descartes's analogical explanation of the propagation of light, explaining light as "nothing but a Company of little Tennis-balls, which Fairies all day long struck with Rackets against some Men's Fore-Heads, whilst they passed by others".²⁷

II.viii.13 extends the account of primary quality perception developed in section 12 to secondary quality perception. Using the same analogy between secondary quality sensations and pain sensations as Descartes, Locke argues that it is no more impossible to conceive that God should annex secondary quality sensations to corporeal motions with which they have no similitude than that he should annex pain sensations to the corporeal motion of "a piece of Steel dividing our Flesh". In contrast, it *is* impossible to conceive that secondary quality sensations should be caused in any other way. In particular, it is inconceivable that the separable qualities that the Scholastics suppose denominate bodies could be transmitted from these bodies to perceiving subjects, thereby interact with their sense organs and produce in their minds the relevant experiences. There is therefore a *metaphysical distinction* between primary and secondary qualities. Secondary qualities are not really qualities at all, but are merely powers (or dispositions) to produce in us ideas, powers that

²⁷ III.iv.10.

depend on the primary qualities of objects. The corollary of this metaphysical distinction is the *conceptual distinction* that whilst our ideas of primary qualities “resemble” those qualities as they are in bodies, our ideas of secondary qualities do not.

By way of illustration, Locke then – and only then – introduces the infamous examples of the fire, manna, porphyry, almond and water, at II.viii.16-21. Consider, for instance, Locke’s discussion of the porphyry. A piece of porphyry, which produces in us sensations of red and white in the light, has no colour in the dark: this much is just supposed to be plain.²⁸ But what could possibly explain this alteration in the porphyry’s qualities? In virtue of what is it coloured in the light but colourless in the dark? We might think, for example, that colours are qualities that literally separate from material bodies in the dark; as Walter Charleton, an English follower of the atomist Gassendi, puts it, that colours are properties “coherent to those superficial particles [of compound bodies], so as...to be actually separated from them, upon the absence of Light”.²⁹ But then the presence or absence of light would somehow have to explain this separation. Yet it follows from the argument of sections 9-15 that we cannot conceive of how the presence or absence of light *could* intelligibly explain this alteration. Given our conception of material substance, the only way in which we can intelligibly conceive of bodies interacting is by impulse. It is therefore only if colours are powers to produce in us sensations that depend on the primary qualities of an object’s insensible parts that we can understand how the porphyry undergoes the alteration that it does. Hence, colours are not qualities of objects, and our ideas of them do not resemble qualities of objects.

3. Resemblance

Before assessing the strength of these arguments for the primary-secondary quality distinction, it is worth briefly pausing to consider the argument’s *conceptual conclusion*: the notorious claim that only our primary quality ideas “resemble” qualities of

²⁸ Although Locke thinks it just “plain” that objects have no colour in the dark, it is interesting to note that Boyle deemed the point worthy of experimental proof, describing an experiment that he conducted with the help of “an ingenious person (skilled in optics)” to determine whether or not snow is white in the dark. Needless to say, neither Boyle, nor his friend, “could find, that it had any other light than what it received”, 1664: 699.

²⁹ 1654: 185; Charleton does not, of course, himself endorse this position.

objects. At least partly on the basis of this claim, some commentators have attributed to Locke a veil-of-perception view according to which ideas are not only the immediate objects of perception, but bear *literally* the same determinable (if not the same determinate) primary qualities as the material objects for which they stand proxy.³⁰

It is worth stressing, however, that nothing in Locke's argument for the claim that only primary quality ideas "resemble" qualities of objects commits him to the view that ideas are literally square or yellow. Although at II.viii.12 Locke acknowledges that we perceive objects that are not "united" to our minds, he does not there say that if external objects are not united to our minds then there must be something - 'real beings', or ideas - that are. This is not the kind of 'wandering soul' argument that we find, for example, in Malebranche, who claims that if the immediate objects of perception were not "intimately joined to the soul" then the soul would have to leave the body and "stroll about the heavens" when it sees objects spatially distinct from itself.³¹ As far as Locke is concerned, the only thing that is "evident" when it comes to the perception of bodies external to the mind is that some motion must be communicated, by our nerves or animal spirits, from our sense organs to our brains, and there produce the particular ideas that we have of them. As to what these particular ideas are, Locke here remains neutral. Of course, this means that ideas could yet be real beings that are literally square and yellow. But, it does not follow that they are, as they could equally be modes or even something entirely different again.³²

To see this more clearly, it is instructive to compare Locke's version of the Interaction Argument with Descartes's. According to Descartes, ideas are modifications of immaterial substance.³³ To the extent that it makes sense at all to talk of modifications as being themselves literally modified, to suppose that a modification of immaterial substance is literally square would require at least that the

³⁰ For a classic statement of this interpretation, see Reid 1785: II.xvii. This interpretation has recently been revived by Winkler 1992 and Jacovides 1999. It receives more qualified approval from Ayers 1991 i: 52-69.

³¹ 1674-5: III.2.1, 217.

³² Although Locke elsewhere professes to find the hypothesis that ideas are real beings, but neither substances nor modes unintelligible (1693a: §18), he does not definitively rule it out, being clear that, "God is not bound in all he does to subject his ways of operation to the scrutiny of our thoughts" (1693b: §2).

³³ 1644: I.9; I.32.

substance of which it is a modification is itself literally extended. Yet, it is an essential property of immaterial substances that they are *unextended*. A ‘square idea’ therefore cannot itself be literally square. For a similar reason, neither can ‘yellow ideas’ be themselves literally yellow. As the more orthodox Cartesian Arnauld says in criticism of Malebranche’s ‘doctrine of the rainbow soul’, for instance:

when it is said that the soul is yellow or green,...that would imply that the soul is something whose surface is covered with the colour green or the colour yellow, something that would be a far greater error than the one we are trying to avoid, since this would suggest that the soul is corporeal.³⁴

The important point here is that if it does not follow from Descartes’s version of the argument for the primary-secondary quality distinction that ideas are literally square or yellow, and Locke’s argument is a version of essentially the same argument, then it does not follow simply from Locke’s version of this argument that ideas are the immediate objects of perceptual experience and bear qualities that literally resemble those of material bodies.³⁵

But if the resemblance claim is not meant literally, what do Descartes and Locke mean when they say that only primary quality ideas resemble qualities of objects? Setting aside questions about the metaphysical status of ideas, a promising suggestion is that “resemblance” should be understood at least in part *metaphorically*, as describing the functional role that ideas occupy. On this reading, to say that an idea “resembles” a quality of an object is to say that it ‘yields an intelligible conception of’ that quality, or, in more explicitly Cartesian language, ‘yields a clear and distinct conception of’ that quality. So, for example, colour ideas do not “resemble” qualities of objects because they do not enable us to intelligibly, or clearly and distinctly, conceive of properties of objects: as Descartes variously says,

³⁴ 1683: Chapter 23, 175.

³⁵ Locke was well acquainted with Malebranche’s views and the disputes these views engendered. During the period on which he was working on *Draft C* of the *Essay*, Locke’s journals contain detailed notes on Malebranche’s *Search After Truth* (7th January to 14th February 1684) and Arnauld’s virulent attack on Malebranche, *On True and False Ideas* (15th March 1684; for details, see Bonno 1955). Later, when in the process of revising the *Essay*, Locke prepared one set of comments directed explicitly at the *Search*, and two sets of comments on the English follower of Malebranche John Norris, whose *Cursory Reflections upon a Book call’d an Essay concerning Human Understanding* was the first published critique of the *Essay*, appearing in 1690. A letter to Molyneux suggests that Locke prepared these comments with an eye towards adding a new chapter to the *Essay* (28th March 1693, de Beer 1976 iv: 665, no. 1620). Locke, however, never made the proposed changes, explaining his decision to Molyneux in a later letter, saying “I love not controversies, and have a personal kindness for the author” (8th March 1695, de Beer 1974 v: 287, no. 1857).

“If someone says he sees colour in a body...this amounts to saying that he sees...something there of which he is wholly ignorant”; there is no “intelligible resemblance” between colours considered as qualities of objects and sensations. Shape ideas, in contrast, “resemble” qualities of objects because they allow us to clearly and distinctly conceive what those qualities are like: “our knowledge of what it is for the body to have a shape is much clearer than our knowledge of what it is for it to be coloured”.³⁶

This metaphorical interpretation of “resemblance” fits Locke equally well, at least to the extent that Locke’s overarching concern in the *Essay* is not so much with ideas considered in themselves, but rather with ideas considered as the “instruments” of knowledge.³⁷ Our ideas of primary qualities “resemble” qualities of bodies insofar as they yield an intelligible conception of those qualities: we are, for example, able to intelligibly conceive of how objects could interact in virtue of these qualities. The same is not of true secondary qualities. We cannot conceive of how objects could interact in virtue of their secondary qualities. Since they do not yield an intelligible conception of any of an object’s qualities, secondary quality ideas do not resemble those qualities.

4. Are Secondary Qualities Primary?

When it comes to evaluating the strength of the mechanistic argument for the primary-secondary quality distinction, one obvious question that arises is whether it is true that sensible qualities like colour fail to satisfy both the *empirical* and *conceptual* criteria for primary quality status? Clearly if they do not, then even assuming the *causal likeness principles* that underwrite the inference from bodily constitution to bodily interaction, there is no reason to suppose that secondary qualities cannot intelligibly explain our perception of them.

The claim that colours fail both the *empirical* or the *conceptual* criteria for primary quality status is something that a number of contemporary critics of mechanistic science tried to reject. In her *Observations upon Experimental Philosophy*, for instance, the atomist turned critic of mechanistic science Margaret Cavendish

³⁶ See 1644: I.68-70. The present proposal builds on the interpretation of Descartes’s understanding of “resemblance” suggested by Wilson 1994.

³⁷ 1690: II.xxxiii.19.

launches a two-pronged attack on the mechanistic denigration of colours to mere secondary qualities.

On the one hand, Cavendish tries to show that colours do not fail to satisfy the *empirical criterion* for primary quality status by considering a number of the examples that mechanists thought showed otherwise. Considering flax or silk divided into small parts, for instance, Cavendish claims that those parts do not “lose their colours, and being twisted, regain their colours”. Rather, the colours of the smaller parts of the flax or silk are simply not subject to our perception.³⁸ Similarly, in response to Boyle’s experiment which purports to show that colour is not an essential quality of objects because objects like snow have no colour in the dark, Cavendish replies that colour is not “lost or lessened in the dark, but it is only concealed from the ordinary perception of human sight”. To suppose otherwise would be absurd: “if colours should not be colours in the dark, then it might as rationally be said, that a man’s flesh and blood is not flesh and blood in the dark, when it is not seen by a human eye”.³⁹

Although Cavendish does not explicitly consider the claim that many objects do, as a matter of empirical fact, look pellucid under a microscope, it is no doubt a claim that she would also reject. Cavendish exhibits a strong disregard for the then burgeoning interest in ‘micrography’, furthered in no small measure by Hooke’s celebrated *Micrographia* of 1665. According to Cavendish, microscopes do not reveal any more accurately the real nature of material objects than ordinary perceptual experience. Indeed if anything, she thinks that, “magnifying, multiplying, and the like optic glasses, may, and do oftentimes present falsely the picture of an exterior object”.⁴⁰

There are still many other examples of supposedly colourless objects that Cavendish does not consider. Underlying her piecemeal argument for the primary quality status of the secondary qualities, however, lies a rejection of the stronger *conceptual* claim that we can even conceive of bodies that lack secondary qualities. According to Cavendish, it is “as impossible to imagine a body without colour as it

³⁸ 1666: 81.

³⁹ Cavendish 1666: 77-8, 86; Boyle’s experiment is described above (in a footnote to the discussion of Locke’s claim that porphyry has no colour in the dark). Note the importance of the analogy Cavendish draws with flesh and blood. Cavendish is vitalist, for whom flesh and blood are amongst the fundamental properties of matter. As such, they are analogous to the primary qualities of her mechanistic contemporaries. For a discussion of Cavendish’s vitalism, see James 1999.

⁴⁰ 1666: 50.

is impossible for the mind to conceive a natural immaterial substance”.⁴¹ It therefore follows from her rejection of the conceptual claim that the empirical claim is false.

I consider in Chapter 2 the general question of whether Cavendish is right to claim that we can conceive of colours existing in the absence of the conditions necessary for their perception: for instance, whether we *can* make sense of the idea that an object’s colours are really just concealed from sight in the dark. For the time being, however, it is enough to note that the stronger claim Cavendish needs to block the argument for the primary-secondary quality distinction – that we cannot conceive of, let alone perceive, colourless objects – is not of itself especially convincing. Even restricting our attention to macroscopic objects, we seem able to make sense of objects lacking colour. The reason why I do not need to open my window to determine the colour of objects on the other side of the road, for instance, is that the pane of glass in my window is more or less pellucid. Unlike coloured or tinted glass, which generally makes colours appear other than they really are, the glass in my window does not affect the perceived colours of the objects that I see through it.

In light of this problem, an interesting variation on this line of argument is therefore found in the more famous critic of mechanistic science, Berkeley. In his later published work, Berkeley actually falls short of endorsing the strong claim that we cannot conceive of colourless objects. When he famously says, for instance, that:

I see evidently that it is not in my power to frame an idea of a body extended and moved, but I must withal give it some colour or other sensible quality which is acknowledged to exist only in the mind

this is weaker than the claim that Berkeley would actually need to deny the premiss of the Descartes-Locke argument. For the premiss of this argument to be false, colour has to be *inseparable* from material substance. But the claim that Berkeley makes at *Principles* I.10 is consistent with the possibility that at least some objects are perfectly pellucid: its just that if they are perfectly pellucid, then there must be some *other* secondary quality (taste, smell, sound, temperature) that we perceive them to instantiate.

⁴¹ 1666: 86.

In his earlier notebooks, however, Berkeley did more directly challenge the claim that colours fail the criteria for primary quality status. But rather than try to resist the claim that there are, or at least could be, objects so pellucid as to lack colour, like Cavendish, Berkeley tried a different approach. Berkeley claims instead that pellucidness is *itself* a colour: “Ask a Cartesian whether he is wont to imagine his globules without colour, pellucidness is a colour”.⁴² Clearly if pellucidness *is* a colour, then the existence of perfectly pellucid objects does not show that colours are not nevertheless wholly inseparable from material substance.

It is difficult, because of the nature of his notebooks, to know exactly what Berkeley had in mind in making this remark. Certainly taken at face value, it does not seem any more plausible to say that pellucidness is a colour than it does to say that there are no pellucid objects. Pellucidness has no place within colour space: it partakes in none of the relations of similarity and difference characteristic of colours. It is not clear that this alone is sufficient to rule out pellucidness as a colour: I argue in response to inter-species variation in Chapter 4, for instance, that having a location within *our* colour space is not a necessary condition of being a colour. The difference between pellucidness and supposedly novel colours, however, is the *way* in which they have no location within colour space. The reason why there is more pressure to admit that pellucidness is not a colour is that we see, through pellucid bodies, the colours of other bodies. To the extent that it makes sense to talk of pellucid objects as coloured at all, they are coloured only derivatively: they have their colour only in virtue of the objects we perceive through them.

But it maybe that Berkeley had something else in mind in saying that pellucidness is a colour, something that is much more worrying for the mechanist’s distinction between primary and secondary qualities. The problem concerns the status of the primary quality motion in mechanistic science. Central to mechanistic science is the law of inertial motion, which states that, in the absence of any interference, objects remain in the same state: for example, that without due cause, what is moving always continues to move and what is at rest never begins to move.⁴³ In order to frame this law of inertial motion, it is necessary to treat motion and rest as states of the same ontological kind. This contrasts with Scholastic theories of

⁴² 1707-8: §453.

⁴³ See, for example, Descartes 1644: II.37.

motion, according to which motion is a process that requires a continuous cause, without which moving objects naturally come to rest.⁴⁴ The admission that rest and motion form an ontological kind, however, generates a problem with respect to the first premiss of the argument for the primary-secondary quality distinction. If the law of inertial motion requires that rest – a lack of motion – be treated as a determinate of the determinable motion, then why can't pellucidness – a lack of colour – also be treated as a determinate of the determinable colour? And if it can, then perceiving (or conceiving of) a transparent object that lacks colour, is still perceiving (or conceiving of) an object that is coloured. Colours, and by parity of reasoning all other secondary qualities, will thereby qualify as primary qualities.⁴⁵

5. Secondary Qualities

Setting these problems aside, however, there is a more fundamental difficulty with the argument for the primary-secondary quality distinction. I have argued so far that Descartes's version of the argument for the primary-secondary quality distinction resembles Locke's. But there is also a striking difference: only Descartes's version of the argument is actually valid.

For Descartes the inference from bodily constitution to bodily interaction at the heart of the argument for the primary-secondary quality distinction is guaranteed by the clear and distinct conception of particular material substances that sensory perception, working in conjunction with the intellect, affords. Locke, however, thinks that we lack the clear and distinct conception of material substance we need to underwrite this inference. For Locke, solid extended substance is ultimately "incomprehensible", because we are unable to determine the nature of the "primary and supposedly obvious" quality of bodies on which extension and figure depend: the cohesion of a body's solid parts.⁴⁶ It follows that no less "obscure and unconceivable" is the only remotely intelligible conception of bodily interaction we can hope to achieve: a conception of the capacity of objects to receive and communicate motion by impulse, grasping which presupposes a grasp of what the

⁴⁴ Koyré 1968: Chapter 1.

⁴⁵ It is interesting to note in light of this that Locke is agnostic on the question of whether rest is properly speaking the "privation" (i.e. lack) of motion at all (II.viii.6). Denying that there is any such thing as absolute rest would seem to be one way of avoiding this argument.

⁴⁶ II.xxiii.26.

cohesion of the parts of matter consists in. According to Locke, we therefore have no more detailed conception of impulsive bodily interaction as “of the passing of Motion out of one Body into another”.⁴⁷

Which all poses a serious problem for Locke’s argument for the primary-secondary quality distinction. Because our conception of material substance is ultimately obscure and confused, it does not follow from the fact that we conceive of bodies as extended, solid, shaped pieces of matter, either in motion or at rest, that this is what bodies actually are. In turn, because our conception of what bodies are determines our conception of how bodies interact, neither does it follow from the fact we can conceive of bodies as interacting only by impulse and on contact that bodies cannot interact in any other way.

The invalidity of the inference from bodily constitution to bodily interaction is graphically illustrated by the revision that Locke makes to the impulsive action principle of II.viii.11 in the Fourth Edition of the *Essay*. In response to Newton’s “incomparable” *Principia*, Locke suppresses the explicit requirement that bodies communicate motion to other bodies only on contact. As he explains in his *Second Reply* to Stillingfleet, the Bishop of Worcester:

The gravitation of matter towards matter, by ways inconceivable to me, is not only a demonstration that God can, if he pleases, put into bodies powers and ways of operation, above what can be derived from our idea of body, or can be explained by what we know of matter, but also an unquestionable and every where visible instance, that he has done so.⁴⁸

But if bodies *could*, and even *do*, act in ways ‘above what can be derived from our idea of body’, why bodies couldn’t act, albeit equally unintelligibly, in virtue of their secondary qualities? It begins to look as though Locke is himself guilty of the same “unfair way” that he remonstrates others for taking who, “because of the inconceivableness of something they find in one, throw themselves violently into the contrary Hypothesis, though altogether as unintelligible to an unbiased Understanding”.⁴⁹

⁴⁷ See, for example, II.xxiii.28, IV.iii.14 and IV.iii.29.

⁴⁸ 1699: 467-8. It is natural to speculate that Locke interpolates the definition of secondary qualities at II.viii.10 in an attempt to obscure the supposedly deductive character of the argument of II.viii.9-15. If this was Locke’s intention, then in light of the confusion that these sections have caused it is fair to say that he succeeded!

⁴⁹ IV.iii.6.

This interpretative problem becomes still more pressing if we consider the explicit role that the “little Excursion into Natural Philosophy” of II.viii plays in the *Essay* as a whole.⁵⁰ The primary-secondary quality distinction is introduced to emphasise the difference between ideas and qualities, and with it the distinction between the inquiry into ideas as they are in the understanding, with which the *Essay* is concerned, and the inquiry into the nature of things as they are in themselves, which falls outside the scope of the *Essay*.⁵¹ To merely emphasise this distinction, however, it is unnecessary for Locke to actually assert the primary-secondary quality distinction; it would be enough to merely conditionally assert it. More generally, establishing the existence of a substantial *metaphysical distinction* between primary and secondary qualities is surely irrelevant when it comes to securing our knowledge of the great ends of morality and religion, with which above all else the *Essay* is concerned. Secondary qualities ideas contribute towards the great ends of morality and religion merely by enabling us to distinguish and re-identify particular material bodies. Locke, however, thinks that they could do this whether they were “a particular Texture of Parts” or else “that very Colour, the *Idea* whereof (which is in us) is the exact resemblance”: in other words, whether there were a *metaphysical distinction* between primary and secondary qualities or not.⁵²

Locke’s problems on this point ultimately stem from his rejection of the Cartesian bifurcation of the mental into distinct sensory and intellectual perceptual faculties. For Descartes, the clarity and distinctness of the conception of individual material substance that we form via the senses, and which grounds the inference to the primary-secondary quality distinction, depends crucially on the interplay between the sensory and intellectual faculties: it is only “as a result of sensory stimulation”, and not through “sensory awareness” alone, that we clearly and distinctly perceive particular material bodies.⁵³ By rejecting this bifurcation of the mental, Locke puts a clear and distinct conception of material substance beyond us. The senses alone cannot furnish us with any such conception, because they are “scarce acute enough to look into the pure Essences of Things”.⁵⁴ And without a clear and distinct

⁵⁰ II.viii.22.

⁵¹ See, for example, II.viii.2 and II.viii.7.

⁵² II.xxxii.14.

⁵³ 1644: II.1. Compare the distinction between the second and third grades of sensory response in the *Sixth Replies* and the account of distance perception in the *Dioptrics*, 1637: VI.

⁵⁴ 1690: II.xiii.24.

conception of material substance, the conceivability claims on which Locke's argument for the primary-secondary quality distinction rest cannot establish the *metaphysical conclusion* of this argument: we can infer neither from our conception of body to the nature of material substance, nor from the nature of body to the nature of bodily interaction.

At the same time, however, part of what makes Locke's version of the primary-secondary quality distinction so attractive is precisely that rejects the Cartesian bifurcation of the mental into distinct sensory and intellectual faculties. The bifurcation of the mental makes it notoriously difficult to accommodate sensation, and secondary quality sensations in particular, within the Cartesian framework. The temptation, to which Descartes typically succumbs, is to treat sensations as elements of perceptual experience distinct from the judgements made about them by the intellect; as he does, for example, in the passage from *Principles* II.1 quoted above. According to this way of thinking it is natural to treat sensations as modes of neither the intellectual mind nor the extended body, but of a third thing, the mind-body union, which constitutes a substance distinct from both the body and the mind, and is that to which sensations are properly referred. Indeed, Descartes himself sometimes appears to treat sensations in this way, most famously when he explains to Princess Elizabeth of Bohemia that we have a "primitive notion" of the substantial union between soul and body, much as we have primitive notions of both the mind and the body. But, of course, this cannot be Descartes's considered view because it violates his commitment to a strict substance dualism.⁵⁵ The official Cartesian view is rather that *all* ideas, including sensations, are modifications of immaterial substance. And this now threatens to make sensory perception just a degenerate case of intellectual perception. To the extent that we think of pure intellectual perception as propositional and non-imagistic, this makes it difficult to respect the distinctive phenomenological character of sensory perception.

Generally speaking, it is not enough that the perceiving mind in which colour sensations are located differ in kind to the material world from which qualities resembling these sensations are expunged. If colours are to be downgraded to the

⁵⁵ Descartes to Elizabeth 21st May 1643, CSMK: 218. Cottingham suggests that Descartes is not a substance dualist but a merely an "attribute dualist", 1986: 127-32. Although this is not so clearly in tension with Descartes's substance dualism, however, it doesn't really address the fundamental problem of explaining the distinctively sensuous nature of sensation: if neither mind nor body are alone well suited to explain the nature of sensation, then how can they explain it together?

secondary quality status of mere dispositions to produce in us sensations, then the mind must itself be able to accommodate these sensations: our ‘ontological dustbin’ has to be up to the task. It should be fairly clear that if there is a problem about how to square the existence of qualities resembling our sensations with the nature of material substance, then it is no better to locate colour sensations in a purely *material* mind. As Thomas Wise, in his abridgement of Cudworth’s *True Intellectual System*, observes, there is almost a logical connection between mechanism and mind-body dualism:

the inward Constitution of [corpuscular] *Philosophy* is also such, that whosoever really entertains it and rightly understands it, must of necessity admit Incorporeal Substance...according to this *Philosophy* the corporeal *Phaenomena* themselves cannot be solv’d by *Mechanism* alone without *Fancy*: Now *Fancy* is no Mode of *Body*, and therefore must needs be a Mode of some other kind of Being in our selves, which is cogitative and incorporeal.⁵⁶

At the same time, however, it does not represent much of an advance over materialism to locate colour sensations in a non-material mind that is itself incapable of accounting for the distinctive phenomenology of sensory perception. In effect, Descartes’s problem is that his essentially intellectual mind is no better able to accommodate the sensations that secondary qualities are dispositions to produce than the material world from which qualities resembling these sensations are eliminated in the first place. The only way in which Descartes can respect the distinctively sensuous nature of sensation is if he predicates sensations of a third substance, the mind-body union. But this avenue is foreclosed by his strict ontological dualism.

Locke’s account of the primary-secondary quality distinction is in this respect much more attractive. By denying the existence of a distinct intellectual faculty, Locke avoids any difficult questions about the relationship of the senses to the intellect, thereby removing any temptation to treat sensation as a merely degenerate case of intellectual perception. Rejecting the existence of a rational intellect may mean that we lack the cognitive capacities to conclusively determine whether mind and body are distinct, or for that matter whether there is a metaphysical distinction between primary and secondary qualities. But mind-body dualism and the primary-

⁵⁶ 1706: 24-5.

secondary quality distinction at least come out as attractive hypotheses, given their ability to account for the distinctive phenomenology of sensation.

One of the things that makes Locke's account of the primary-secondary quality distinction attractive is therefore precisely that in virtue of which his argument for this distinction is invalid. It is precisely *because* he rejects the Cartesian distinction between the sensory and intellectual perceptual faculties that Locke's argument for the distinction is at once invalid, and yet more compelling than Descartes's valid version of same the argument. Rejecting the Cartesian bifurcation between the senses and the intellect, whilst at the same time accepting a fundamental distinction between mind and matter, allows Locke to respect what is phenomenologically distinctive about secondary quality perception. And this, after all, is exactly what we want from a theory of colour.

[2] The Mind-Independence of Colour

...real colour persists beneath appearances as the background persists beneath the figure, that is, not as a seen or thought-of quality, but through a non-sensory presence.
Merleau-Ponty 1945: 356.

Descartes and Locke assume that the vulgar – as it happens, erroneously – conceive of colours as mind-independent properties that are metaphysically on a par with the primary qualities of corpuscularian science: size, shape, motion, and perhaps solidity. I consider the kind of problem that Descartes and Locke raise for this view – that of locating colours within the natural world – towards the end of the thesis. Before then, however, it is first necessary to get much a much firmer grasp on what the common sense view of colour actually consists in. Of particular importance is the question of the mind-independence of colour.

The view that common sense already implicitly regards colours as mind-dependent properties itself has a distinguished history. With its origins in Berkeley, the view has proved especially popular in Oxford, where, in one form or another, proponents have included John Cook Wilson, H.A Pritchard, Gilbert Ryle, William Kneale, Gareth Evans and John McDowell. As Kneale, describing what we can call the *Oxford View of Colour*, puts it:

When Locke said that the secondary qualities were powers in things to produce sensations in us, he stated the facts correctly, but he did not realize that his statement was only an analysis of the plain man's use of secondary quality adjectives...When in ordinary life we say 'The paper isn't really red', we always intend to imply that the paper has some other colour as a dispositional property.¹

The first question that we need to consider is therefore just what the naïve conception of colour is. §2.1 sets out a criterion for mind-independence and considers Evans's version of the argument that colours fail to satisfy this criterion. §2.2 identifies, and sets aside, a slippage in Evans's statement of this argument: from the conceptual claim that we *conceive* of colours as mind-dependent properties to the metaphysical claim that colours *are* mind-dependent properties. In §2.3, I argue that the conceptual mind-dependence of colour is inconsistent with the crucial role that

¹ Kneale 1950: 123. Compare Cook Wilson 1904: 773-4, Pritchard 1909: 86-7, Ryle 1949: 209, Evans 1980: 272-4 and McDowell 1985: 112. Pritchard's statement of the view is perhaps the most guarded. Pritchard thinks that mind-dependence is implicit in all our secondary quality concepts *except* colour, and only then given a "little reflection" (although admittedly, not much).

colours play in our grasp of the mind-independent existence of material substance. After loosening the traditional link between mind-independent existence and sensory amodality in §2.4, I therefore reconsider Evans's argument for the mind-dependence of colour in §2.5. The idea of a 'geometrical' description of colour is introduced in support of the claim that our conception of colour is a conception as of a mind-independent quality. Geometrical descriptions of colour, in which colours are abstractly described in terms of their characteristic relations of similarity and difference, offer a way of conceiving of colours in terms that are only indirectly tied to our sensory experiences of colour. Geometrical descriptions of colour thereby enable us to make sense of the idea that colours are mind-independent properties that are *there to be perceived*.

1. Mind-Independence

To say that something is *mind-independent* is to say that it does not depend for its existence on the relation that it bears to the experiences of perceiving subjects. Something is *mind-dependent* if, in contrast, its existence does so depend on experience.

At least in the first instance, we are interested in questions of mind-independence to the extent that we are able to recognise of a thing whether or not it is mind-independent; whether, that is, we can conceive of it existing independent of our experiences of it. This presupposes possessing a workable *criterion for mind-independence*. Following Evans, himself following amongst others Strawson, we can say that we can conceive of an entity as mind-independent only if we are able to embed it within a *simple theory of perception*. This amounts to recognising the "implicit duality" of our experiences of that entity. We need to grasp, as Evans puts it, that:

on the one hand, there is *that of which there is an experience* (part of the world) and, on the other, there is *the experience of it* (an event in the subject's biography).²

The rationale for this criterion is to capture the intuition that our experiences are responsive to the features of the world of which they purport to be

² Evans 1980: 277, 261-3, Strawson 1959: 69. Compare Campbell 1993: 180. In the background here is the question of how Evans and Campbell can agree about the criterion for mind-independence, but disagree about whether secondary qualities like colour satisfy this criterion.

representative: that we experience a cup as round precisely *because* it is round, or that we experience a marigold as yellow precisely *because* it is yellow. What being able to embed an entity within a simple theory of perception, and so make sense of its mind-independent existence, requires, is that we have an independent way of conceiving of that which the sensory experience is an experience *of*. Without an independent conception of the entity, we cannot hope to make sense of the distinction between the experience and the entity necessary for recognising its mind-independent existence. Attempting to conceive of the non-experiential side of the equation – the entity in the world to which the experience is responsive – we succeed only in *re*conceiving the experiential side of the equation. The problem is familiar from Berkeley and Hume. If the content of our conception of a thing is exhausted by the content of our perception of it, then as Hume says, even if we:

chace our imagination to the heavens, or to the utmost limits of the universe; we will never really advance a step beyond ourselves, nor can conceive any kind of existence, but those perceptions, which have appear'd in that narrow compass.³

Assuming that a necessary condition of conceiving of a thing's mind-independent existence is that we have a way of thinking about it that is one step removed from our sensory experiences, there is a distinguished tradition which claims that secondary qualities like colour fail to satisfy this requirement. A clear expression of this view is found in Evans's investigation into the nature of, and pre-conditions for, a conception of an independently existing world.

Possessing a conception of a mind-independent world requires that a subject be able to make sense of the existence of persisting grounds of the sensory phenomena that they experience: they have to be able to make sense of the idea that those grounds exist unperceived. *We* have a conception of a mind-independent world because *we* can conceive of the unperceived existence of material objects. We have the resources to think about the qualities essential to our conception of material objects as “*space-occupying stuff*” independent of the sensory experiences to which these qualities give rise. This, according to Evans, is because the sense of our spatial, primary quality, concepts is not distilled directly from sensory experience. It

³ 1739-40: 1.2.6, 49. As Cook Wilson remarks, what is needed to make sense of the idea of independent existence is a “positive content different – quite different – from [our experience], and clearly distinguishable from it”, 1904: 773.

is determined instead in part by a *primitive mechanics*, “a set of interconnected principles which make up an elementary theory...into which these properties fit”.⁴ As such, there is content to our conception of properties like size, shape, motion and mass that is independent of our sensory experiences of these properties.

A greatly impoverished subject, Hero, whose perceptual access to the world was exclusively auditory, however, may not be so fortunate. We are able to conceive of the unperceived existence of secondary qualities like colour and sound because according to Evans we have a conception of the persisting space-occupying properties of objects which ground the truth of secondary quality ascriptions. Hero’s conception of the auditory phenomena that exhaustively comprise his world, however, would according to Evans be “directly and exclusively...woven out of materials given in [auditory] experience”. As such, Evans suggests that Hero would be incapable of an independent conception of that which his experiences are experiences *of*. Without any conception of the persisting grounds of the auditory phenomena that he experiences, Hero would be unable to embed his auditory experiences within the simple theory of perception necessary for an intelligible conception of mind-independent existence. He would therefore be unable to make sense of the unperceived existence of these auditory phenomena, and so have no conception of mind-independent world.

Central to Evans’s argument for this conclusion is the claim that the auditory experiences Hero enjoys could not themselves contain the materials to ground a conception of an independently existing world. The auditory phenomena Hero experiences could only ground a conception of a mind-independent world if he could conceive of sounds as properties that resembled his experiences of them, but which continued to exist in the absence of those experiences. According to Evans, however, reflection on our secondary quality experience shows that this is a conceptual impossibility: we cannot conceive of secondary qualities existing unperceived, yet being exactly as we experience them to be. Instead, the only way in which we can conceive of secondary qualities existing unperceived is by virtue of conceiving of the mind-independent existence of their primary quality grounds.

⁴ 1980: 269. Whether a primitive mechanics is in fact both necessary *and* sufficient for a conception of mind-independent existence is considered below, in §2.5.

Consider, by way of illustration, the question of whether colours exist in the dark. To suppose that objects are *not* coloured in the dark belies the claim that colours are abiding, mind-independent, properties of objects. It makes their existence depend upon the obtaining of the conditions necessary for their perception. But if colours can exist unperceived, then they have to be able to exist when the conditions necessary for their perception do not hold: when there are no suitably placed, suitably receptive perceivers, when the illumination is inadequate, and so on. On the other hand, the idea that objects *are* coloured in the dark is, at least initially, “quite obscure”. How could a ‘colour-as-we-see-it’ exist when we cannot see it, and how could our experience of colour enable us to form a conception of such a state of affairs? It is, according to Evans, indicative of the fact that our secondary quality concepts are woven exclusively out of the materials given in sensory experience that we cannot break the fundamental tie between sensory experience and the content of our secondary quality-thoughts that the recognition of mind-independent existence requires. When, for instance, we try to conceive of an object that is red in the dark, “[w]hat, after all, is being imagined but experiencing a red object that is unseen by anyone *else*”?⁵

For Evans, the distinction between primary and secondary qualities is therefore a distinction between those properties whose nature is exhaustively captured by the conception of them that it is possible to distil directly from (‘pure’) sensory experience, and those properties whose nature cannot be captured in this way. Secondary qualities are properties whose entire nature is directly revealed in sensory experience. They are properties to which there is nothing more than meets the eye.

2. Properties and Concepts

According to Evans, no positive content can be assigned to our conception of colours independent of our sensory experiences of colour. Evans himself slips freely

⁵ 1980: 274. We are, as Cook Wilson had earlier complained, “always thrown back on the sensation itself for positive content, and can only give a derivative positiveness to the property the body has of causing it, by thinking of it as producing this definite quality of effect.”, 1904: 773-4. Compare Pritchard 1909: 86-7 and McDowell 1985: 113.

from talk about concepts to talk about the properties to which these concepts refer.⁶ But to say that there is no more positive content to our *conception* of colours than can be distilled directly from sensory experience is not yet to say that colours are themselves *properties* whose nature is exhaustively captured by our sensory based conception of them. For all that has so far been said, colours could therefore be qualities whose essential nature escapes us. As Bolton points out in the context of (given what I say in Chapter 1, mis-) attributing a similar argument to Locke, there is no straight-forward way of ruling out the possibility that there exist aspects of the world that transcend our experience of it. The claim:

rests on an argument from ignorance, or perhaps on the false assumption that whatever is distinctive of ideas of various colours is manifest. In fact, even if we have failed to notice a distinctive, separable feature of the content of an idea of red, one which could belong to something unperceived, there may still be one.⁷

In other words, the most that Evans has established so far is merely that there is a *conceptual* distinction between primary and secondary qualities: primary qualities are qualities of which our conception outruns the conception that it is possible to form on the basis of pure sensory experience, whilst secondary qualities are qualities of which no non-sensory conception is possible. To draw from this *conceptual* distinction a further *metaphysical* distinction would require assuming something like the “adequacy” of our secondary quality concepts. It would require assuming, as Hume puts it, that “Wherever ideas are adequate representations of objects, the relations, contradictions and agreements of the ideas are all applicable to the objects”.⁸ In response to Evans’s argument, the adequacy of our secondary quality ideas is therefore something that we may wish to question.

Certainly the view that there is more to colour than is revealed in so-called pure sensory experience is not obviously incoherent. Short of accepting idealism, verificationism, or a Cartesian epistemology of clear and distinct ideas, there does not appear to be any *a priori* reason to suppose that our ideas must be adequate, and

⁶ A nice example of this is when he claims that “To grasp...primary properties, one must master a set of interconnected principles”, 1980: 269. Bill Child brought this example of Evans’s seemingly unconscious slippage from talk about concepts to talk about properties to my attention. As he pointed out, what we grasp, of course, are *concepts* of properties, and not the properties themselves: except, that is, when we literally pick up the material objects that bear the qualities!

⁷ 1983: 363.

⁸ 1739-40: 1.2.2, 24.

hence that the world must conform to our conception of it. Nevertheless, the default position should at least be that our ordinary thought about colour is *not* systematically mistaken. Unless, for instance, we can confer extra content on our conception of colours by means of physical theory, we will have to conclude that the non-sensory residue about which visual experience is silent is a something-we-know-not-what. Not only would this involve a metaphysically dubious commitment to, what Cook Wilson calls in a slightly different context, something “even worse than ‘a thing in itself’, viz. ‘an attribute in itself’”.⁹ But such a manoeuvre would be entirely *ad hoc*. There is no independent motivation to postulate the existence of such an attribute in itself. It would certainly be cold comfort for Hero to be told that at least his lacking the capacity for thought about a mind-independent world is consistent with its existence.

Besides, merely doubting the adequacy of our secondary quality concepts concedes to Evans too much. To doubt the adequacy of our secondary quality concepts is to agree with Evans that the mind-dependence of colour is implicit in our ordinary thought about colour. But to suppose that colours *are* conceptually mind-dependent fails to account for the important role that colours play in our grasping the mind-independent existence of material substance in the first place.

3. Colour and Material Substance

Conceiving of a quality as mind-independent requires that we be able to make sense of the ‘implicit duality’ of our experience. We need to be able to distinguish between the quality and our experience of the quality.

The very least that this would seem to require is that the quality exhibit *perceptual constancy*: that we perceive it as persisting through changes in its appearance. It is, for instance, indicative of our ability to recognise the mind-independence of qualities like size and shape that we are able to distinguish the way these qualities *appear* from the way these qualities really *are*. We recognize, that is, that the real sizes and shapes of objects do not themselves change with changes in the way that they appear due to variations in the body’s distance from the perceiver, its orientation with respect to the perceiver, the ambient conditions, and so on. Although, for

⁹ 1904: 780.

example, railway tracks may *appear* to converge in the distance, we do not think that they *really* do.

But if the recognition of perceptual constancy is indicative of the recognition of mind-independent existence, then our conception of colour is as much a conception of a mind-independent property as our conception of size and shape. Colour, no less than size and shape, exhibits perceptual constancy. The way in which colours appear depends on a wide variety of factors. Take, just by way of illustration, facts about the illumination. To see the effect of the type of illumination on perceived colour, just turn on an incandescent desk lamp in a naturally lit room. You will see that there is a very noticeable change in the colour appearances of the objects that the lamp illuminates.¹⁰ Despite these kinds of phenomenologically salient variation in perceived colour, however, we do not normally attribute changes in the colour *appearance* of an object to changes in its colour *properties*. We judge instead that an object's colour is generally invariant through changes in the conditions under which the object is perceived.

The phenomenological salience of colour constancy is worth stressing, as it is something that physiological explanations of colour constancy in terms of low-level, pre-attentive, adaptational visual mechanisms typically fail to respect. According to the adaptational theory of the German psychologist Ewald Hering, for example, differences in proximal stimulation do not translate into differences at the phenomenological level because constancy is achieved by the desensitisation of retinal and immediately post-retinal cones to light that is constantly present; in the same way that looking through a pair of green tinted spectacles desensitises the retinal cones that are particularly sensitive to middle-wavelength 'green' light, effectively filtering this light out, and thereby making the visual scene seem at lot less green.¹¹ Even discounting cases of constancy involving simultaneous contrast effects, in which there is *no* change to the illuminant and hence in which no adaptation can take place, however, the adaptation model does not respect the phenomenology of colour constancy. For one thing, adaptation is a relatively slow process, taking anything up to a few minutes: as you can verify by putting on a pair of green tinted glasses. Colour constancy, however, is instantaneous. But even if

¹⁰ Craven and Foster 1992.

¹¹ Hardin 1988: 48.

adaptation were instantaneous, it would still get the phenomenology wrong. Adaptationism effectively discounts changes in the illuminant from attentive consideration: on this view, changes in illumination simply would not be noticed. But this is just false to the phenomenological facts. As the simple lamp experiment shows, changes in facts about the illuminant *are* phenomenologically salient. Indeed, that they are may even have significant evolutionary advantages, providing important information about weather conditions, the time of day, the proximity of large bodies, and so on.¹²

The perceptual constancy of size and shape is indicative of mind-independence. Our conception of these properties as mind-independent in turn depends, according to Evans, on the ‘theoretical’ nature of our spatial concepts. It is the primitive mechanics into which our spatial concepts fit that Evans thinks supplies the extra non-sensory content necessary to conceive of shape and size independent of our experiences of these qualities. The phenomenon of colour constancy suggests that our colour concepts are no less ‘theoretical’.

Amongst the things that we need to learn in order to grasp our colour concepts, for instance, is that the properties to which these concepts refer are not affected by certain changes in the properties of other objects in the visual scene. We need to learn, for example, that marigolds remain yellow regardless of the background against which they are seen, the nature and intensity of the illuminant, their distance and angle from the observer, and so on. At the same time, we need to know that on still other occasions an object’s colour *is* affected by the interactions of the body in which it inheres. If we stain the flower using a blue dye, for example, then our marigold will turn green, just as a yellow paint sample mixed with a blue paint sample will produce a paint sample that is green.

Neither is it just the ways in which colour properties affect, or fail to affect, other colour properties that we need to master. We also need to know, for example, that by changing the colour properties of an object we can change its higher level functional and aesthetic properties. If we paint a referee’s yellow-card red, for

¹² Jameson and Hurvich 1989. As the phenomenologist Katz says of Hering’s adaptational account of colour constancy: “Paradoxical as it may at first sound, such a thoroughgoing efficiency on the part of the adaptive mechanisms as Hering postulates is not even to be considered as desirable; for it would partially or wholly compensate for any change in illumination, and thereby make it imperceptible”, 1911: 264. von Helmholtz’s rival interpretation of colour constancy as a kind of “unconscious inference” is no less problematic in this respect. If the inference from proximal stimulus (perceived colour) to distal stimulus (real colour) is pre-attentive, then this too involves discounting the illuminant.

example, then the card no longer serves to caution football players, but to send them off. Similarly, if red and green really should never be seen without a colour in between, accessorising red trousers and a green jumper with a yellow belt is good sartorial advice.

More importantly, although colours may not themselves directly affect the more fundamental properties of bodies like shape, size or motion, mastering a primitive theory of colour is integral to grasping even the mind-independent existence of the properties essential to our conception of bodies as space-occupying stuff. To grasp the concepts fundamental to the idea of space-occupancy we need to master a set of interconnected principles, which, as Evans suggests, include “the identity of matter perceived from different points of view...[and] the persistence of matter through gaps in observation”.¹³ Integrating our theory of colour *into* our primitive mechanics represents a means of achieving this end.

Colours allow us to distinguish, identify and reidentify material substances: they are, as Locke puts it, “Marks of Distinction in Things, whereby we may be able to discern one Thing from another; and so chuse any of them for our uses, as we have Occasion”.¹⁴ Similarity in respect of colour, for instance, is one of the principles in virtue of which the visual system partitions the visual scene into discrete material objects in the first place. The common colour of different parts of the visual scene will often serve as the basis for treating these parts as parts of the same object, as Figure 2.1 illustrates. Whilst the array on the left is naturally perceived as three columns of four dots, it is at least as natural to perceive the spatially identical array on the right as four rows of three dots: the similarity in respect of colour of the dots across the rows leads us to group these dots together.

¹³ 1980: 269.

¹⁴ 1690: II.xxxii.14.



Figure 2.1: Gestalt Grouping Phenomenon

The array on the left is naturally perceived as three columns of four dots, whereas it is at least as natural to perceive the spatially identical array on the right as four rows of three dots.

Part of the reason why we regard a piece of paper lying on a table as a distinct material object from the table is that the piece of paper is white and the table on which it is placed brown. Indeed, it is partly because of the similarity in respect of colour of the unoccluded parts of the table that we think that there is a single object – a table – there at all. As the Gestalt psychologist Koffka remarks, a general law of “unit formation and segregation” is that “equality of stimulation produces forces of cohesion, inequality of stimulation forces of segregation, provided that the inequality entails an abrupt change”.¹⁵

The importance of colour for segregating areas of the visual field into discrete material objects is reflected in the phenomenon of colour spreading. Cases of modal completion, in which subjective figures ‘pop out’ from their background, as in Figure 2.2a, are often accompanied by colour spreading, in which colour and brightness spread from neighbouring regions into a region where they are physically absent, as in Figure 2.2b. Modal completion contrasts in this respect with amodal completion, as in Fig 2.2c, when one figure merely partially occludes another. Davis and Driver suggest that although both modal and amodal completion are the result of similar (if not the same) pre-attentive mechanisms, only modal completion is accompanied by colour spreading because it is only for modally completed objects that we want attention to spread across the completed object’s entire surface. In the case of partially occluded objects, in contrast, we merely want attention to spread to the visible parts of the object. Colour spreading facilitates this: by spreading from neighbouring regions into modally completed areas from which it is absent, colour allow us to treat the different areas as parts of a common object.¹⁶

¹⁵ 1935: 126. It should be noted that similarity with respect to colour is not the only principle of unit formation and segregation recognised by Gestalt psychologists.

¹⁶ Davis and Driver 1997.

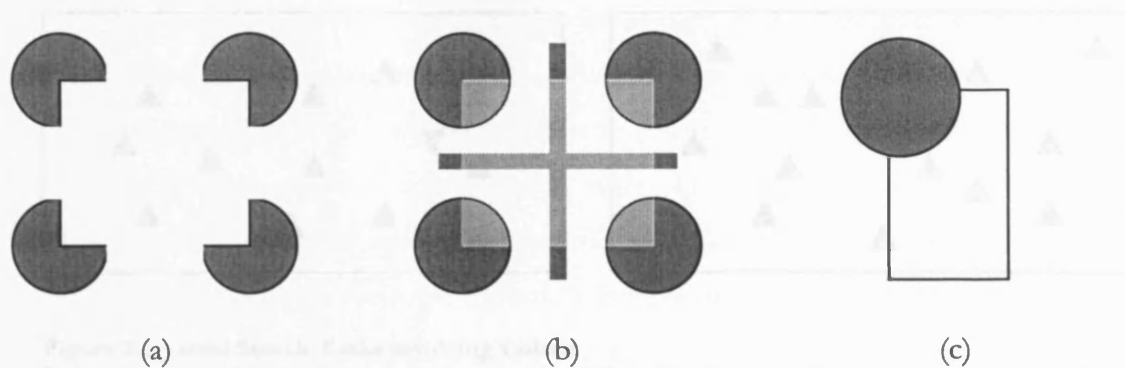


Figure 2.2: Modal and Amodal Completion

In cases of modal completion like 2.2a, subjective figures 'pop out' from their backgrounds. Modal completion is often accompanied by colour spreading, as in 2.2b. Cases of amodal completion like 2.2c, in which one object is merely perceived to partially occlude another, are not accompanied by colour spreading. Source: Davis and Driver 1997.

Having served to partition a visual scene into discrete material objects, colour subsequently helps with the identification of objects within the scene. Colours ground many of the distinctions that we make between material objects. One advantage that colour vision confers, for instance, is that it facilitates distinguishing material objects from their backgrounds. A common complaint made by subjects who are colour blind is that they are unable to discriminate with the same ease as normal perceiving subjects objects from their backgrounds. Boyle, for instance, describes the case of a gentlewoman who:

when she had a mind to gather Violets, tho' she kneeled in that Place where they grew, she was not able to distinguish them by the Colour from the neighbouring Grass, but only by the shape, or by feeling them.¹⁷

At the same time, colours also greatly improve our ability to identify objects, or groups of objects, that lie in the same plane; much more so than other visual attributes like direction, as Figure 2.3 illustrates: the odd-one-out 'pops out' more freely from amongst its surroundings if it differs in respect of colour than other visual attributes. It is no doubt partly for this reason that football teams, for instance, play in differently coloured kits rather than differently shaped, sized or textured, kits.¹⁸

¹⁷ 1688: 267-8. See Mollon 1989: 381-2 for a number of other quotations to the same effect.

¹⁸ According to Christ 1975, if the task is to identify some feature of a target, colours can be accurately identified at least 176% better than size, 32% better than brightness and 202% better than shape.

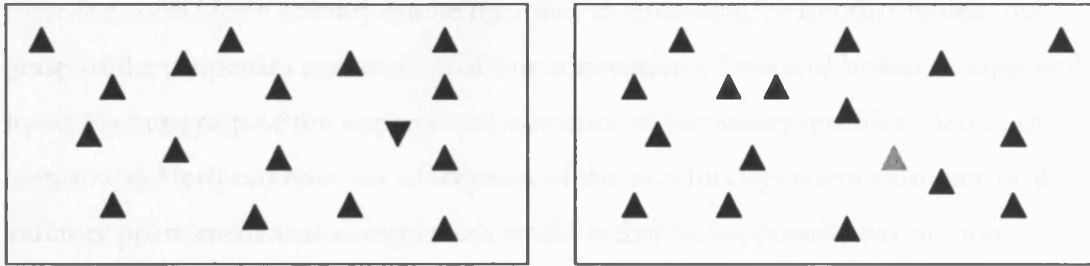


Figure 2.3 Visual Search Tasks involving Colour

Colour is processed much faster than other visual attributes like direction. The odd-one-out 'pops out' more freely when it differs in colour than when it differs in orientation.

As well as facilitating the identification of material objects in a scene, colours subsequently ground higher-level categorical thought about objects. Colours, for instance, represent one of the cues that we use to delineate material objects into kinds. Poisonous mushrooms are (generally) red, edible mushrooms (generally) aren't; unripe bananas are green, bananas that are ready to eat are yellow; grey clouds generally signal rain, white clouds generally don't. The role of colours in grounding categorical thought about material objects is suggestive of a tight link between an object's colour and facts about its material constitution. It suggests that colours are not just accidentally correlated with material substances, but integral to them.

Moving from the identification of material substance to their reidentification, colours play no less important a role. One way to determine whether objects persist through gaps in our observation of them is by reference to the persistence of their colours. If, for instance, a piece of paper on the floor is the same colour as the piece of paper that I left on the table before, then this will usually be sufficient to ground my belief that it is the same piece of paper, but it has just fallen off the table in the meantime.

Colours could not fulfil any of these functions, however, if we implicitly thought of them as mind-dependent properties. According to the Oxford View of Colour that Evans defends, our grasp of primary quality concepts is prior to our grasp of secondary quality concepts. Recognising the unperceived existence of colour is supposed to presuppose a grasp of the primary qualities constitutive of our conception of material bodies as space-occupying stuff: this gives us the "resources for thinking of the abiding stuff in whose changes the truth of the proposition that

there is a sound [or a colour] can be regarded as consisting”.¹⁹ In other words, our grasp of the properties constitutive of our conception of material bodies is supposed to *explain* our grasp of the unperceived existence of secondary qualities. Hence, the reason why Hero can have no conception of the mind-independent existence of the auditory phenomena that comprise his world is that he supposedly has no non-auditory conception of that which grounds these sounds.

The problem for Evans is that our conception of material bodies as abiding space-occupying stuff itself depends in part on a mind-independent conception of colour. Our judgements about material objects and their persistence depend in part upon our judgements about sensible qualities and their persistence: it is, for instance, at least in part because we conceive of an object’s *colour* continuing to exist unperceived that we conceive of the *object* as continuing to exist unperceived. But colours can only help ground our judgements about the unperceived existence of objects if we *already* have a conception of colours as mind-independent properties. It cannot both be the case that our grasp of the mind-independence of colour depends upon our grasp of the mind-independence of the spatial qualities essential to material substance, and that our grasp of the mind-independence of the spatial qualities essential to material substance depends on our grasp of the mind-independence of colour.

In claiming that our understanding of what it is to be coloured is parasitic upon on our grasp of what it is to be material object, the Oxford View of Colour goes hand in hand with the thought that colours are in some sense ‘stretched’ over the surfaces of material objects; they are like the ‘clothing’ of material substances. The view of colour that Evans ascribes to common sense is therefore neatly described by the intellectual ancestor of the Oxford View when, claiming to be of a “vulgar cast, simple enough to believe my senses, and leave things as I find them”, Berkeley claims to believe that “colours and other sensible qualities are *on* the objects”.²⁰ But this is just not how we think of colours. As Hering’s famous shadow experiment illustrates, there is a world of difference between conceiving of colours as properties that lie *on* the surfaces of material substances, and conceiving of them as properties *of* those objects. If you hang a bit of paper from a silk thread in front

¹⁹ 1980: 278.

²⁰ 1713: 229, emphasis added.

of a lamp so that the paper casts a shadow onto a piece of writing paper, you see the dark shadow as “an incidental darkness that lies on the paper”. But this is not to see the darkness as a property *of* the paper. We can induce this aspect shift if we draw around the shadow with a black line that completely covers the shadow’s penumbra. When we do this, it no longer appears as though the darkness lies on the surface of the paper, the darkness appears to be a property of the paper: it is, Hering remarks, “as if the white paper were coloured grey here with India ink, or as if a piece of grey paper with a black edge had been pasted on the white paper”.²¹

Just as Berkeley’s idealism about the external world presupposes an impoverished account of our primary quality concepts, Evans’s Berkelian conception of colour as a mind-dependent property presupposes an impoverished account of our secondary quality concepts. We do not think of colours as merely clothing material substances, and if we did, colours could not play the role that they actually play in our mastery of the principles which explain our conception of material bodies as mind-independent entities. Colour, no less than size and shape, is essential to our conception of material substance as persisting space-occupying stuff.

4. Amodality and Mind-Independence

To say that it is only if we conceive of colours as mind-independent properties that they can play any role in grounding our conception of the mind-independent existence of material substance is not yet to say *how* it is that we conceive of colours as mind-independent properties. Recognising the perceptual constancy of colour requires that the sense of our colour concepts be determined at least in part by a primitive theory into which these concepts fit. But it does not look as though this will of itself be sufficient to establish the mind-independence of colour. For one thing, it does not seem to go any way towards meeting the Berkelian challenge posed by Evans: how are we able to conceive of colours existing in the dark without simply thinking of how they would look to suitably placed suitably receptive perceivers if the conditions necessary for their perception held?

With this in mind, it will help to consider in more detail exactly why an analogous problem does not arise in the case of the paradigmatically mind-

²¹ Hering 1920: 8.

independent properties shape and size. Why is it that – unless we are Berkeley – we do not think that there is a problem about conceiving of the persistence of shape in the dark? An obvious difference between colour and shape is that unlike colours, shapes are properties to which different sensory modalities are equally responsive. Perhaps, then, it is the amodality of shape that ultimately grounds our conception of shape as mind-independent.

The general suggestion that mind-independence and amodality are inexorably linked certainly has a distinguished history, and has recently been defended by A.D. Smith. Following Berkeley, Smith claims that the concept of an objectively existing world can only be sustained on the assumption that our access to this world is not restricted to perceptual information received from individual sense modalities:

an essential aspect to our concept of an external world...is what we might call *inter-modal sensory access*: an objective realm is one to which our several senses are, in principle, equally responsive.²²

According to Smith, the different sense modalities are defined by the sensory characteristics of the experiences to which they give rise. The difference between the auditory and visual modalities, for example, consists in the “peculiar and indefinable way” in which auditory perceptions differ from visual (e.g. colour) perceptions. Labelling those concepts associated exclusively with an individual sense modality “peculiarly sensory concepts”, Smith locates what he considers to be the abiding truth of seventeenth century metaphysics in the idea that secondary qualities are unique in corresponding to our sensorily determined concepts: they are qualities that are represented relative to a sensorily determined conceptualisation. As such, they have no place within a genuinely explanatory science:

how [secondary qualities]...are represented in thought and experience, and *what* they are pre-theoretically taken to be, are determined by intrinsic sensory features of perceptual experiences that the objects themselves lack.²³

Secondary qualities differ, in this respect, from spatial-temporal qualities such as shape and figure, which are not represented in experience by characteristics

²² 1990: 242.

²³ 1990: 237. In other words, “What pre-scientifically we know when we are said to know what redness is is nothing about the actual state of any red object other than that it is of such a nature as standardly to cause colour *qualia* within in a certain range”, 1990: 240.

peculiar to one sense. Rejecting the Berkelian assumption that *all* of our concepts are peculiarly sensory – from which Berkeley argues that there is *no* mind-independent external world – Smith argues that spatial-temporal concepts instead transcend the different sense modalities, and represent properties to which we have access via more than one sensory modality. By transcending the different modalities, spatio-temporal concepts provide the structural framework necessary for experience as of an objective world; a framework that is subsequently further filled out by reference to the “theoretical properties...specified by a theoretical science in terms of law-like behaviour”, necessary for the recognition of material substance as space-occupying stuff.²⁴

Though intriguing, however, Smith’s suggestion that amodality is necessary for mind-independence rests on two controversial claims. The *first* is that the defining mark of secondary qualities is that they are represented by peculiarly sensory concepts. We have already called into question the supposed contrast between concepts of secondary qualities and concepts of ‘theoretical’ properties: at least in some minimal sense, it seems that grasping secondary quality concepts too presupposes grasping a primitive theory. But setting this to one side, there is a more general problem. According to Smith, the mode of presentation of a secondary quality is determined by the intrinsic nature of the sensory experience in which it is represented. These sensory characteristics of perceptual experience in turn define the different sensory modalities. The consequence of this is that according to Smith, colours could only appear as colours to sight. A creature able to distinguish colours only by touch, for instance, would enjoy a radically different mode of presentation of these qualities than we do. Consequently, were this creature suddenly to be able to see, and taught how to distinguish colours visually, it would be unable to integrate the information it received from its visual and tactual modalities.²⁵

But why should we accept this? In the case of spatio-temporal properties, phenomenological modality-specificity does not entail conceptual modality-specificity. Despite differences in the phenomenological character of tactile and visual experiences of shape, for example, we are prepared to accept that the concepts formed as a result of these experiences do not themselves differ. As Smith

²⁴ 1990: 249.

²⁵ Compare Peacocke 1983: 35.

himself admits, sight and touch “embody *identical* spatial concepts”.²⁶ But why suppose that this could not also be the case with respect to the sensible qualities as well?

Consider taste and smell. Even ignoring those situations in which a smell is so strong that it feels as though we can actually taste it, and concentrating purely on cases where we are happy to grant that there is at least *some* phenomenological difference between taste and smell, that there is any corresponding difference in the concepts formed on the basis of these experiences is far from obvious. Arguably the *smell* of week-old milk, for instance, alerts us to exactly the same quality of the milk as the *taste* of week-old milk; namely that the milk has gone off. Just as it is tempting to think with Smith that, “*I learn nothing new* when I touch a cube and thereby feel it to be a cube, if I can all the time see that it is a cube”, so it seems that the olfactory and the gustatory perceptual judgement that the milk is off also embody precisely the same thought. *I learn nothing new* when I taste the milk and thereby taste it to be off, if at the same time I can smell that it is off.

The problem is not just confined to secondary quality experiences of smell and taste. As of yet there is no reason to deny that even in the case of colour, despite phenomenological differences in visual and tactual experiences of colour, sight and touch could embody identical colour concepts. Of course, as a matter of empirical fact, *we* do not possess the right kind of sensory organs to perceive colours non-visually. *We* therefore cannot imagine what such an experience would be like. But why assume that if there could be a creature able to detect colours non-visually that, on gaining sight, it would be unable to integrate its visual and tactual modalities? The mere inconceivability of this seems insufficient grounds for ruling out its possibility. If we are prepared to accept that sight and touch embody identical spatial concepts with respect to shape and size, then why not accept that sight and touch *could* embody identical spatial concepts with respect to colour?

Of course if, following Berkeley, we suppose that *all* our concepts are necessarily sensorily determined, and therefore that the idea of an amodal concept is simply incoherent, then things would be different. There would be a reason to reject the possibility that sight and touch could embody identical colour concepts, namely *no* concept could be amodal. In the absence of any independent reason for thinking

²⁶ 1990: 242.

that sight and touch could not embody an identical colour concept, however, it begs the question to suppose that a creature able to distinguish colours by touch would be unable to integrate the information it received from its visual and tactual modalities were it suddenly able to see, and taught how to distinguish colours visually.²⁷

Even if we grant that secondary qualities are proper sensibles, however, the *second*, and more controversial of the two controversial claims that Smith needs to establish is that a mind-independent conception of something anyway presupposes amodal sensory access to it. According to Smith, the mode of presentation under which secondary qualities are experienced is determined by modality-specific properties of perceptual experience. The result is that secondary qualities are represented by peculiarly sensory concepts. Even if we agree with Smith that colours *could* appear as colours only to sight, however, why suppose that this tells us as much about visual experience as about the nature of the *properties* experienced? For all that has so far been said, it is consistent with the proper sensibility of colour that colours are mind-independent properties that are such that no direct amodal perception of them is possible.

Indeed, returning to the original Berkelian problem posed by Evans, amodal sensory access to a property is not even *sufficient* to grasp its mind-independent existence (not that Smith himself necessarily claims otherwise). Merely appealing to the amodality of shape, for instance, cannot help us answer the Berkelian challenge of conceiving of the existence of shape in the dark. It cannot be just because we can perceive shapes via a different sensory modality that we are able to conceive of shapes existing in the dark. If there is a problem about conceiving of unperceived existence on the basis of the sensory information that we receive from one sensory modality, then simply adding in more information of the same kind cannot help. Just as we can imagine situations in which the conditions necessary for the visual perception of the object do not hold, so we can imagine that the conditions necessary for tactile perception do not hold either. Perhaps, to use Descartes's example, whenever we move our hands in a given direction, all the bodies in that

²⁷ Sorabji 1979 discusses the case of Rosa Kuleshova, reported in *Time* (25th January 1963), who could allegedly distinguish colours and read print with her fingertips, without relying on the texture of the paper. Kuleshova's claims may, as a matter of empirical fact, have been false. But, as Sorabji suggests, it is not clear that they are conceptually incoherent.

area move away at the same speed as that of our approaching hands, and so we never tactually experience them.²⁸ Even so, we still think that objects retain their shape. The question is why? What is it about our conception of shape that allows us to think of shapes persisting through gaps in our perception of them?

5. The Geometry of Colour

A different contrast between colour and shape is that shapes enjoy a ‘wider cosmological role’ than colours: they explain a body’s interactions with non-sentient objects. The reason why it may in contrast seem difficult to conceive of the mind-independence of colour is that colours are just too closely tied to the reactions of perceiving subjects. This tie is clearest when we consider the effects of illumination and contrast on the *perceived* colour of an object, or the effect of colour on an object’s higher-level functional or aesthetic properties, which both clearly involve a relation to human interests and responses. Even when it comes to integrating colours into our conception of material substance, or explaining the effects on an object’s colour on the colour of another object, however, the responses of perceiving subjects are never very far from the surface. It is, for instance, *our* capacity for distinguishing and reidentifying material objects that is at stake when it comes to determining the relationship of colours to the material objects in which they inhere. It is similarly to *our* responses that the effects of colour mixing are ultimately to be referred: mixing yellow and blue paint, for example, produces paint that would *look*, to suitable observers, the same colour as grass. Although our colour concepts may therefore be governed by a primitive theory, it may ultimately seem to be the wrong kind of theory to secure the conceptual mind-independence of colour. Perhaps the trouble is that the primitive theory of colour just does not move far enough beyond the deliverances of colour experience.²⁹

But this too misdiagnoses the problem. Even if colours enjoyed a wider cosmological role, this would not solve the problem of conceiving of their

²⁸ 1644: II.4.

²⁹ Evans, for instance, remarks that *we* are able to conceive of the unperceived existence of the buzzing sound because we conceive of the event of the fly’s moving its wings (the persisting grounds of the buzzing sound) as an event “consisting in space-occupying objects, possessed of qualities characterised *independently of observers*, moving in relation to one another”; 1980: 278-9, emphasis added.

unperceived existence.³⁰ The problem is not about the scope of our primitive theory of colour, but about primitive theories more generally. To grasp a primitive theory governing a set of concepts is to grasp how the properties to which the theory's concepts refer contribute to the ways in which their bearers interact with other things. In effect, it is to grasp the functional role associated with those properties. What makes our ability to conceive of colours as mind-independent properties seem problematic is not the fact that the functional role associated with colour makes ineliminable reference to perceiving subjects. The problem is more general than this. The problem is that grasping *any* primitive functional theory is not of itself sufficient to ground a conception of a property's abiding, mind-independent, existence.

Consider our grasp of the mind-independent existence of an object's primary spatial qualities. The persistence of these qualities does not depend upon their bearer's interactions with other objects, of which conscious subjects are just a subspecies. An object's spatial qualities are *there anyway*, independent of whatever else might be the case. Grasping the abiding existence of an object's primary qualities therefore requires not just that we be able to make sense of their persistence through gaps in their bearer's interaction with perceiving subjects, but also their persistence through gaps in their bearer's interaction with other *material substances*. But how could mastering a primitive functional theory governing primary qualities of itself explain our grasp of this?

Evans asks whether we can conceive of colours existing in the dark; in the absence of the conditions necessary for colours to exhibit their characteristic functional role. If we merely think in terms of the primitive theory into which our colour concepts fit, then we cannot conceive of how colours could exist in the dark. We are forced back onto the contribution that colours make to the causal interactions of their bearers: we are forced back onto thinking of how objects *would look* if the conditions necessary for their producing in us the relevant colour experiences held. But an exactly analogous problem arises for an object's primary qualities. Consider a lonely world object: a frictionless object spinning in the void.

³⁰ Suppose, for instance, that it were in virtue of being black that black things heat up more quickly than white things. As it happens, colours do not affect the interactions of their bearers with non-sentient beings in this way. As Brookes points out (1992: 194), it is not in virtue of being black that black things heat up more quickly than white things: the functional role conferred on an object by being black is that it fail to reflect visible light; what explains the heating up of the black object, however, is its failure to reflect invisible infra-red light.

Of itself, a primitive theory could give us no way of thinking about the persistence of this object's spatial qualities in the absence of the conditions necessary for the object to exhibit the characteristic behaviour associated with those properties. In the absence of the object's interaction with other material substances, we can only conceive of its continued persistence by thinking about how the object *would* interact with other objects if the necessary conditions held; perhaps even by implicitly thinking of its continued interaction with one particular sub-species of object, conscious subjects. The spatial qualities conceptually essential to material substance are therefore no less subject to a Berkelian challenge than colours. In this case what, after all, is being imagined but experientially interacting with a frictionless spinning object that is interacting with nothing *else*?³¹

If merely grasping a primitive theory is of itself insufficient to grasp the abiding existence of the properties conceptually essential to material substance, then in virtue of what do we conceive of material substances as persisting space-occupying stuff? Perhaps what is special about the spatial qualities that are conceptually essential to material substance is not that these properties are amodal, nor that they explain an object's interaction with non-sentient substances, but rather that our grasp of the primitive functional theory governing these properties is parasitic upon our grasp of non-functional, intrinsic, facts about these properties. Maybe it is our grasp of these non-functional facts that grounds our ability to conceive of the primary qualities conceptually essential to material substances as persisting through gaps in the conditions necessary for their bearer's casual interactions with other bodies.

We can think about shapes, for example, by thinking of the internal relations that shapes bear, not to determinates of other determinable properties, but to other determinates of the determinable, *shape*. That is, we can think about how shapes are similar to, and different from, other shapes. By thinking about the internal relations

³¹ Hence the rhetorical force of the *reductio* implied in Strawson's response to Evans: "If it seems true of the sensory properties in general that they all dissolve together, under reflective pressure, into dispositions, this seems even more certainly true of the 'physical' properties which are held to constitute their categorical base", 1980: 280. The Oxford View that colours are ordinarily thought of as dispositional properties had earlier been embedded within a wholly general dispositional theory of properties by Ryle 1949. Evans, however, is keen to distance himself from this position. Evans's claim that Hero lacks a conception of a mind-independent world depends on the idea that a "deep conceptual prejudice" (1980: 276) of ours is offended by dispositions without categorical grounds, like those presupposed by Ryle's generally dispositional theory of properties.

that hold between different shapes, we have a way of thinking about shape that is independent, both of the interactions with other material bodies into which objects enter in virtue of being shaped, and of the interactions with perceiving subjects into which objects enter in virtue of being shaped.

Thinking about relations between determinate shapes, for instance, is independent of, and indeed prior to, thought about the functional roles associated with shape properties, insofar as grasping a property's functional role *presupposes* a grasp of its relations to other determinates of the same determinable. It is hardly possible to grasp how a shape affects a body's interactions if we don't first know what that shape *is*. To know what a shape *is*, however, is at least to know the ways in which it is similar to, and different from, other shapes. We do not know what squareness is, for instance, if we do not grasp that square things are more like triangular things (with respect to the number of their sides) than they are like circular things.

At the same time, thinking about the relations between determinate shapes is independent of thought about their interactions with perceiving subjects – that is, how shapes *look* or *feel* – because we can think about the similarities and differences between determinate shapes in abstract terms. At the limit, for instance, we can represent similarities and differences between shapes by similarities and differences in the equations of analytic geometry that we use to describe these shapes: the greater similarity between squares and triangles than between squares and circles, for example, can be represented by the greater similarity between the equations used to describe squares, triangles and circles. Being able to conceive in abstract terms of properties like shape gives us a way of making sense of that which our shape perception is perception *of*. It gives us a way of thinking about the properties of which our experiences purport to be representative, that is independent of those experiences. It thereby gives us a way of conceiving of shapes as mind-independent properties.

But as for shape, so for colour. Just as there are ways of thinking about shapes that are not directly tied to the way in which objects interact in virtue of being shaped, there are ways of thinking about colours that are only indirectly tied to the way in which objects interact in virtue of being coloured; which, given the ineliminable reference to colour experience in the primitive theory into which our

colour concepts fit, amounts just to there being analogous ways of thinking about colours that are only indirectly tied to our sensory experiences of colour. Consider a determinate colour like yellow. To know what yellowness is in itself, independent of the ways in which objects interact in virtue of being yellow, is at least to know what position yellow occupies within the network of determinate colour properties, a network defined amongst by other things the relations of similarity and difference in which different determinate colours stand. It is at least to know, for instance, that yellow is more similar to orange than red, more similar to chartreuse than green, and more similar to either red or green than blue.

The relations of similarity and difference that hold between the colours jointly define a *property space*. Property spaces are abstract structures that can be represented using multidimensional spatial models, in which properties are mapped onto different points in the model in order to represent salient structural relations between them. The precise nature of the multidimensional spatial model that you use to represent colour space will vary depending on precisely which structural relations you want to emphasise: in an empirically adequate representation of a colour space, for instance, similarities between the colours will be represented by distances between the points in the space, although this strict isomorphism can be relaxed in order to highlight other structural relations between the colours. At least for illustrative purposes, however, just consider the most common spatial representation of colour space: the basic three-dimensional colour space, as represented in Figure 2.4, in which colours are arranged along the three axes,

hue: whether the colour is red, yellow, green, blue, or some mixture of these;

saturation (or *chroma*): the proportion of hue relative to a neutral

achromatic point; or, more roughly, the ‘strength’ of the hue;

lightness (or *value*): how much black, white or grey the colour contains.³²

³² The three values hue, saturation and brightness are not universally recognised as necessary and sufficient for the description of any given colour sample, but will at least suffice for illustrative purposes. Note also that colour space is often called *psychological* colour space, betraying the fact that the received view of colour amongst visual scientists is that colour is a ‘psychological’ property of visual experiences.

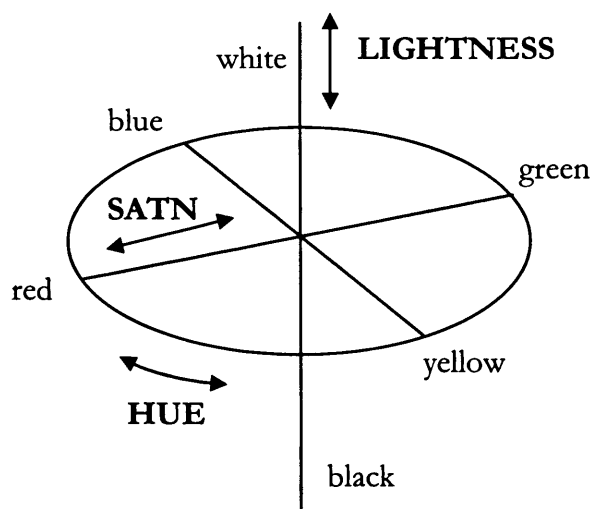


Figure 2.4: Three-Dimensional Colour Space
 Colour samples vary along three dimensions: hue, saturation and lightness.

Abstract representations of colour space formalise the way that we have of thinking about colour at one step removed from our sensory experience of colour. These representations reflect our ability to conceive of colours without just thinking of how the colours would look in the relevant perceptual situations. Although colour space is sometimes represented with the relevant colour samples occupying the relevant spatial regions, it does not have to be represented in this way. Different colours can be designated instead by names or numbers that uniquely locate different regions of colour space. Indeed, it is not even necessary that the relations of similarity and difference in which the colours stand be represented in explicitly spatial terms at all. The network of properties that the colours constitute could be equally well represented just using mathematical formulae. The important point is just that the internal relations of similarity and difference in which colours stand, and which colour spaces represent, afford us the independent way of conceiving of that which our colour experiences are experiences *of*, necessary for recognising the mind-independent existence of colour. It gives us a way of thinking about colours without simply thinking about how they would look in the relevant circumstances.

Looking ahead to Chapter 4, our ability to conceive of colours independent of our sensory experiences of colour is graphically illustrated if we compare normal human colour vision with that of other species. Using stimulus-response experiments, we can determine third-personally facts about the colours that other

species perceive. There is evidence to suggest that pigeons, for instance, can perceive more colours than humans: they are not only sensitive to a greater range of spectral wavelengths than humans, but their visual processing mechanisms are more complex than our own. This is not just to say that pigeons are able to make more fine-grained discriminations between colour samples than humans, either. The colour properties pigeons perceive appear to be qualitatively different from the colour properties that we perceive.

Human hues, for instance, can be divided into two mutually exclusive classes: *elemental* and *binary*. Instances of the elemental hues, red, yellow, green and blue, can be identified as containing no trace of any other colour, and taken together the elemental hues are minimally sufficient for the description of any other hue sample. The binary hues, orange, chartreuse, cyan and purple, in contrast, are always perceived as a mixture of other colours: orange, for instance, is always perceived as a mixture of red and yellow, chartreuse, yellow and green, and so on. Consequently, the binary hues are not minimally sufficient for the description of any other hue sample: we cannot describe red in terms of orange and purple in the way that we can describe orange in terms of red and yellow. Pigeons, in contrast, seem to not only perceive a greater number of elemental hues than humans, correspondingly more binary hues, but possibly even a completely different kind of hue, ‘ternary hues’, which are like our binary hues but mixtures of *three* different elemental hues: this would be the equivalent of seeing something that is a mixture of red, green and blue.³³

What such colour properties look like is beyond our powers of sensory imagination: there is simply no way of adequately representing these colours in the three-dimensional space in which it is possible to locate our own colour properties. Simply conceiving of these properties in terms of the sensory experiences that they would produce in suitable observers is therefore out of the question: we cannot imagine what those experiences would be like. But we are not thereby bereft of *any* conception of these properties. We are at least able to abstractly describe the structure of the space that these properties define.

³³ Thompson 1995: 141-60. I argue in §4.2 that there is actually reason to suppose that pigeons do not strictly speaking perceive *hues* at all, but for present purposes this point is not important.

[3] Illuminating ‘Real Colour’

The layman...is convinced that external objects have intrinsic colours...He ascribes to these colours an existence that is independent of the eye, designates them as the *real* colours of the objects in question, and distinguishes them from the *incidental* colours that the same objects may show under unusual circumstances, for example, in illumination that is inadequate or that deviates strongly from ordinary daylight. The red of the mountain peak in the alpenglow, the pallor of a face that is illuminated by sodium light, the coloured spot on a floor when sunlight falls on it through a coloured window pane, are such incidental colours which we relate to the momentary nature of the illumination and do not take as properties of the objects in question.

Hering 1920: 6-7.

I have argued so far that the view of colour implicit in our ordinary thought is that colours are mind-independent properties: they are properties that exist independent of our experience of colour, and hence the conditions necessary for our experience of colour. The relevant contrast is with broadly speaking relational theories of colour, according to which colours are properties whose nature is metaphysically dependent upon the material objects, perceiving subjects and environmental conditions that are their *relata*; accordingly for which a difference in *relata* entails a difference in the relation that the *relata* constitute. This, however, is to make a merely *conceptual* claim: it is to make a claim about how we conceive of colours. In Strawsonian terms, the exercise up until this point has merely been an exercise in “descriptive metaphysics”.¹ Nothing that I have said yet goes any way towards establishing the *metaphysical* conclusion that colours really are mind-independent properties. It therefore so far remains an open question whether our common sense conception of colour is adequate to the real nature of colour.

Although it would be nice if colours are what ordinarily think they are, there is considerable pressure to suppose that this is not the case. I will return to the problem of locating mind-independent colours within the natural world in Chapters 6 and 7. Before then, however, it will be helpful to consider a less *recherché* challenge to the mind-independence of colour based on familiar facts about perceptual variation, starting in this chapter with perceptual variation that is the result of differences in the environmental conditions, and differences in the illumination in particular: inter-species differences in colour perception will be the subject of Chapter 4 and intra-species differences are dealt with in Chapter 5. Considering this

¹ 1959: 9.

less *recherché* challenge to the mind-independence of colour will in turn put us in a better position to understand exactly what the common sense view of colour amounts to.

After making sure that the inquiry into the metaphysical reality of colour is even on a secure footing in §3.1, I outline in §3.2 the general form of the Argument from Perceptual Variation, which attempts to undermine a consequence of the naïve view that colours are mind-independent properties: the distinction between the colours objects really are and the colours they merely appear to be because of facts about the situation in which they are perceived. Variations in colour appearance that are the result of differences in viewing distance and background are considered in §3.3, whilst §§3.4-5 consider perceptual variation that is the result of differences in illumination. In each case, albeit for different reasons, I suggest that the differences in perceived colour do not undermine the common sense view that colours are mind-independent properties.

1. The Quest for Reality

Before considering the Argument from Perceptual Variation directly, however, it is important to make sure that the investigation into our common sense thought about colour is in good conceptual order. Is the reality of colour even up for discussion?

We have already voiced suspicions about the most direct line of argument that could be used to bypass discussion of the reality of colour: the inference from the conceptual claim that we ordinarily *conceive* of colours as mind-independent properties to the metaphysical claim that colours *are* mind-independent properties. If this approach is not just to collapse into idealism, then there must be some *a priori* principle that guarantees the inference from the way we conceive the world to be to the way that the world really is. The prospects for identifying any such principle are, however, bleak. Certainly neither a Cartesian epistemology of clear and distinct ideas, nor verificationism, two of the most famous attempts to bridge this gap, seem especially promising (§2.2).

An interesting variation on this general strategy, however, has recently been proposed by Barry Stroud. Rather than argue that our ordinary thought about colour is veridical, Stroud argues instead that our common sense conception of colour is

immune to critical evaluation. According to Stroud, our ordinary thought about colour can neither be validated nor invalidated because we cannot even get ourselves into the position to critically examine our ordinary beliefs about colour, such that we *could* find those beliefs to be systematically true or false.

At the heart of Stroud's argument is the idea that would-be "unmaskers" – people who try to explain away our ordinary beliefs in the existence of colour without requiring that they be true, as we might explain away beliefs in ghosts or God – are unable to identify in the first place the beliefs whose truth they call into question. In order to give an unmasking explanation of our colour directed psychological attitudes, it is clearly necessary to acknowledge that people have a great number of perceptions of, and beliefs about, colour. Furthermore, ascribing these psychological attitudes to other subjects requires that the unmasker have at least some grasp of the properties on which these attitudes are directed: they have to be able to at least identify what properties it is that we ordinarily (but erroneously) ascribe to physical objects in thought and perception.

The unmasker has to be able to do this, however, without themselves referring to any colour properties of material objects, given that *ex hypothesi*, material objects are colourless. If the unmasker can identify the thoughts and perceptions whose truth they want to unmask without themselves believing that material objects are coloured, then they can identify the relevant thoughts and perceptions without having to hold the contradictory beliefs that material objects are, and are not, coloured. The unmasker can maintain that ordinary consciousness is systematically mistaken in attributing the experienced properties to material objects. Instead, they can hold that our colour thoughts and perceptions are in fact just thoughts and perceptions about properties of the visual field, or properties that figure in the intentional contents of experience but have no real bearers at all.

Stroud, however, is sceptical that the unmasker could identify the relevant experiential properties without assuming that they are properties of material objects. To ostensibly or demonstratively identify these properties you need to have a set of background beliefs that uniquely determine the reference of the demonstration; otherwise it is just left indeterminate which experiential properties you mean to demonstrate. But Stroud thinks that amongst these background beliefs will be

beliefs about the colours of material objects, precisely those beliefs to which the unmasker cannot appeal. This, according to Stroud, is because:

For those who are competent in the use of colour terms, the property they take themselves to see in a perception of colour is the same property that they believe a physical object to have, in the belief that it is coloured.²

In other words, if unmaskers do not understand themselves to perceive properties of material objects, then they do not succeed in identifying the properties about which the rest of us ordinarily have psychological attitudes. And this just means that they do not succeed in identifying the perceptions and beliefs that they set out to unmask.

From the failure of the unmasking project to establish the conclusion that objects are not 'really' coloured, neither does Stroud think that we can draw the contrary conclusion that colours 'really' exist. According to Stroud, we are left in exactly the same epistemic position as we found ourselves before embarking on the 'quest for reality'. We find ourselves surrounded by material objects that appear to be coloured, with no way of going beyond these appearances to discover whether appearance and reality coincide. Returning a positive answer to the quest for reality presupposes exactly the same as returning a negative answer: that we can get ourselves into the position to ask the question in the first place. Either way we need, *per impossibile*, to:

consider all human perceptions and beliefs concerning the colours of things, on the one hand, and the world as it is independently of us, on the other, and still manage to ask a still-open question about the relation between them.³

If Stroud is right, then the ordinary belief that material objects are coloured is beyond critical investigation. Although this falls short of vindicating our ordinary thought about colour outright, it at least gives us a short way with the prevailing view that colour experience is systematically mistaken. The question is just whether Stroud's arguments establish this exciting conclusion. And unfortunately, they do not.

² 2000: 166.

³ 2000: 192-3.

Even if what Stroud says about the unmasker is correct, Stroud's scepticism about the prospects of returning a positive verdict to the quest for reality is misplaced. The colour realist is not in nearly so bad a position as the unmasker. The problem for the unmasker is to identify the psychological attitudes whose truth they want to unmask without presupposing any beliefs about the colours of material objects, given that *ex hypothesi*, material objects are not coloured. But there is no direct analogue of this problem for the realist. The realist starts with our beliefs about the colours of objects, and working backwards, tries to identify a metaphysically acceptable property that would render some, or all, of those beliefs true. There is no problem for the realist in appealing to our ordinary thoughts about and perceptions of colour in order to do this if, *ex hypothesi*, objects really are coloured.

But if Stroud's arguments do not rule out realism about colour, then the spectre of error remains. The unmasker does not have the monopoly on error. Realism about colour is consistent with the attribution of error to ordinary colour experience. According to the physicalist, for instance, colours exist, but have a hidden essence that ordinary visual experience does not reveal: for instance, they are properties in virtue of which objects modify electromagnetic light. Although ordinary consciousness correctly ascribes colours to objects, it does not tell us what, essentially, those properties are: it tells us the truth, but not the whole truth. The relationist also thinks that objects really are coloured, but they couple this with the claim that in ascribing colours to objects ordinary thought commits a category mistake: it mistakes merely relational mind-dependent properties of objects for intrinsic mind-independent properties.

Stroud elsewhere offers independent arguments at least against relationist theories of colour, if not physicalist theories of colour as well.⁴ Rather than consider the details of these further arguments, however, I want to just consider Stroud's argument against the unmasker. Even if these further arguments are successful, there are problems with Stroud's arguments against the stronger unmasking strategy. Things are not as difficult as Stroud maintains even for the unmasker.

⁴ Stroud criticises relationist theories of colour in Chapter 6, prior to attempting to unmask the unmasker's strategy in Chapter 7. Stroud does not consider physicalist views of colour directly, although some of the earlier considerations concerning the 'idea of physical reality' (Chapter 3) bear at least indirectly on this question.

Stroud's objection turns on the idea that the unmasker cannot identify the perceptions and beliefs they want to unmask without illicitly appealing to perceptions and beliefs about properties of material objects, perceptions and beliefs which by their own admission are systematically false. The Wittgensteinian considerations about ostensive definition to which Stroud appeals require that there be some way of uniquely specifying the property on which these psychological attitudes are directed: there has to be some way of 'setting the stage', so we know precisely which properties it is that we mean to ostensively identify. But even accepting this, why must it be that the only ways of recognising the properties we perceive, and about which we have beliefs, are as properties *of* material objects? Why must the unmasker refer to beliefs about "what sorts of things he thinks can have the property" in order to identify the colours?⁵

Although I have argued so far that our ordinary conception of colour is in fact a conception of a mind-independent property of material objects, there are other beliefs about colour that could set the scene. I have argued, for instance, that essential to our grasp of the mind-independence of colour is a grasp of the internal relations of similarity and difference in which colours stand. But if grasping facts about the relations between different colours puts us in a position to think of colours as mind-independent properties of material substances, then it should also put us in a position to entertain the thought that these mind-independent properties do not really exist. Perceptions of, and beliefs about, the internal relations between colours allow us to fix the reference of our colour terms. They therefore put us in a position to know which properties the unmasker means to deny the mind-independent existence of.⁶

2. Appearance and Reality

The failure of more or less *a priori* attempts to safeguard our ordinary thought about colour requires us consider this view, and its consequences, more directly.

⁵ 2000: 165.

⁶ Compare Johnston's remark that, "The conditions on thinking about the colors, on identifying particular colors, and on identifying one's visual perceptions as ostensibly of the colors of things, are sufficiently holistic to allow for a range of 'package deals' only some of which require endorsing ordinary first-order beliefs about the colors", 2004: 196.

It follows from the common sense view that colours are mind-independent properties that there is a sharp distinction between the colours objects really *are* and the colours they merely *appear* to be because of facts about the situation in which they are perceived. This appearance-reality distinction falls out, subject to a qualification below, just from the claim that colours do not depend for their existence on our experience, and hence the conditions necessary for our experience, of colour. At the same time, this commitment to a sharp appearance-reality distinction is often thought to present a serious problem for the naïve view that colours are mind-independent properties. The problem, it is claimed, is that the idea of an object's 'real' colour dissolves under even minimal critical scrutiny.

The classic modern statement of this argument is Berkeley's 'First Dialogue'. In response to Hylas's claim that material substances have "true and real colours inhering in them", Berkeley's spokesman Philonous makes short work of the distinction between real and apparent colour, very quickly convincing the hapless Hylas that there is no such thing as an object's real colour, and that colours are really "all equally apparent". Berkeley starts by identifying a conflict of appearances: that is, he starts by identifying an object, *x*, that appears to have two incompatible properties, *F* and *G*. Assuming that *F* and *G* are incompatible, and both properties of the same object, then at least one of the appearances must be merely apparent: *x* must merely appear *F*, or merely appear *G*, or both. To say either that *x* only appears *F*, or that *x* only appears *G*, however, presupposes some criterion by which to judge which appearance is illusory. In the absence of a non-arbitrary reason to regard either appearance as illusory, Berkeley concludes that *x* is *really* neither *F* nor *G*. Schematically:

Argument from Perceptual Variation

1. *x* appears to be *F* and *x* appears to be *G*
2. *x* cannot be both *F* and *G*
3. there is no non-arbitrary reason to regard either appearance as illusory
4. therefore, *x* is really neither *F* nor *G*.⁷

⁷ Berkeley 1713: 184-6. Earlier versions of this argument can be found in Malebranche 1674-5: 63-6, 441-2, and much earlier still, in ancient Greek atomists like Democritus. More recently, this kind of argument has been used to motivate eliminativism about colour by, for example, Hardin 1988, and used to motivate relationist theories of colour by, amongst others, McGinn 1983, McLaughlin 2003, and Cohen 2005.

In effect, the question that I consider over the next three chapters is whether, in the face of the Argument from Perceptual Variation, the appearance-reality distinction can support the weight placed on it. Before considering this question in detail, however, a few general points about the Argument need to be made.

The *first* is that the Argument from Perceptual Variation often forms parts of the more general ‘argument from illusion’. The argument from illusion attempts to establish a conclusion about the nature of perceptual experience: traditionally, that perceptual experience is constitutively dependent upon either a certain kind of subjective object – a sense-datum – or else upon a certain kind of subjective, experiential property – a *quale*.

Berkeley, for instance, uses facts about perceptual variation to argue that colours are subjective properties of inner subjective objects (‘ideas’). At least some subsequent proponents of the traditional argument from illusion have questioned Berkeley’s inference from the subjectivity of colours to their interiority. C.I. Lewis’s use of the term “*qualia*” to refer to properties of that which is “given” in sensory experience, for instance, leaves it open whether these subjective qualities exist in physical space, outside the mind.⁸ G.E. Moore’s introduction of the term ‘sense-data’, as that which is directly apprehended in sense perception, similarly leaves it open whether sense-data exist without the mind. Although Moore ultimately thinks that sense-data are not in fact parts of the material world, Moore concedes that it is at least “*conceivable* that this whitish colour is really on the surface of the material envelope”.⁹ The conclusion that “*sensa*” (sense-data) are states of mind is one that C.D. Broad even provisionally rejects. Broad claims to be unable to find any good arguments in support of this position, and indeed thinks that the view is fraught with problems. Echoing the kinds of criticism we saw Arnauld make of Malebranche in §1.3, Broad complains that:

something is said to be a state of mind, though it possesses properties which it is very difficult to ascribe to states of mind. If a sensum is a state of mind, then there are states of mind which are literally red or round or hot or loud or triangular, and so on...I find it difficult to believe that any state of mind actually *is* a term of this sort.¹⁰

⁸ “What is given may exist outside the mind – that question should not be prejudged”, 1929: 64.

⁹ 1910-11: 31.

¹⁰ 1923: 106.

Whatever the metaphysics of the direct objects of perception, however, these writers at least agree that the Argument from Perceptual Variation tells us something interesting about the nature of perceptual experience: they agree that it tells that an experience (or 'presentation') logically implies the existence of something that it is an experience (or presentation) of, be this a sense-datum or *quale*, internal to or external to the mind.

In what follows, however, I am going to set aside questions about the wider significance of perceptual variation. Questions about the nature of colour are largely independent of questions about the nature of perceptual experience.

On the one hand, further argument is needed to move from facts about perceptual variation to facts about perceptual experience, as even the dispute between different subjective theories of perception illustrates. Indeed, the fact that perceptual experience is at least sometimes subject to variation is not even sufficient to establish the subjectivist's conclusion that experience is constitutively dependent upon a subjective object or property in the first place. Intentionalists about perception, for instance, reject the existential commitment of subjective theories of perception on the grounds that subjective objects or properties are unnecessary to explain the possibility of perceptual experience. According to intentionalists, perceptual experience is just an intentional state with a certain kind of representational content: no further explanation of the character of visual experience is necessary or perhaps even possible. Disjunctivists, on the other hand, reject the inference to subjective entities by rejecting 'the common kind assumption' that underwrites the move from the possibility of illusion to the conclusion that we are only ever directly aware of subjective entities. According to disjunctivists, veridical and non-veridical experiences differ fundamentally in kind: one is a direct awareness of mind-independent material objects and their properties, the other something else. The important point is that whatever the disagreement between these different theories is, it is not about the facts of perceptual variation. All three theories acknowledge that perceptual variation can, and indeed does, occur. Their disagreement is about *independent* assumptions involved in the subjectivist's response to this variation.

On the other hand, even if we accept the subjectivist's conclusion that our colour experiences *are* constitutively dependent upon certain kinds of subjective

object or quality, this does not anyway entail anything about the metaphysical status of colour. It is consistent with subjective theories of perception that material objects exist, that they are really coloured, and that the subjective objects or qualities that we immediately perceive literally resemble these qualities of material objects. The further conclusion that material objects are not really coloured requires additional argument: for instance, either that colours have no location within the ‘scientific image’, or perhaps even that the very notion of material substance is incoherent.¹¹ But this *is* further argument. The subjectivity of colours does not follow simply from a subjective theory of perception.

The *second* general point to make about the Argument from Perceptual Variation is that ‘real’ is, as Austin points out, context sensitive. ‘Real’ is a word whose negative use “wears the trousers”, insofar as the sense of ‘real’ in a given context is determined by the intended contrast. ‘Real’ can be used to mark a contrast with something that, though natural, is unusual – a ‘real’ summer, unlike the miserable one we had last year. It can be used to mark a contrast with the artificial – a ‘real’ (natural) blonde, as opposed to someone who has dyed their hair. It can be used to mark a contrast, amongst artificial things, with the fake – a ‘real’ Rolex, in contrast to a cheap imitation. It can even be used in the way that proponents of the argument from illusion fix on, to mark a contrast with the non-existent – Katy has finally got herself a ‘real’ friend, instead of the imaginary one she was playing with last week.¹²

The context sensitivity of ‘real’ does not mean that we cannot sensibly discuss the question of whether objects are really coloured. But it does mean that we have to fix the relevant contrast. The relevant contrast in the present context is with the colour an object appears to have as a result of facts about the situation in which it is perceived. Of course, as Austin also points out, ‘appears’ is itself context sensitive. If, for instance, you look at railway tracks from the ground with the usual visual clues, there is a clear sense in which they appear, not to be convergent, but parallel and receding into the distance. Similarly, if you look at a white wall illuminated by a blue light and you can see the illumination independent of its

¹¹ For a discussion of the broadly physicalist argument against literal resemblance, see Broad 1923: 125-9. Recent subjectivist proponents of this argument include Jackson 1977, Boghossian and Velleman 1989 and Smith 1990.

¹² Austin 1962: 62-77, especially 70.

interaction with the wall, there is a clear sense in which it does *not* appear to you that the wall is blue. Because of the perceptual constancy of colour, the wall actually appears to be a white wall illuminated by a blue light.

But it is not this sense of the word ‘appear’ that we mean. When we say that the relevant contrast is with ‘the colour an object appears to have’, it is with local appearance properties that we are interested: it is the colour an object appears to be absent any non-local features of the visual scene that might serve as visual cues to its real colour. We are interested, for instance, in the colour the wall appears when we discount from consideration the nature of the illuminant, by screening it off from attentive consideration using either a reduction screen, a matchbox lid or just half-closing our eyes. Roughly speaking, the colour an object appears to be is the colour that we would need to paint a canvass to faithfully represent the visual scene of which it is a part: the white wall appears blue because if, for instance, you were to paint a picture of the wall you would paint it using blue paint, not white paint.¹³

The *third* general point to make about the Argument from Perceptual Variation, before considering this argument more directly, is that we should not assume at the outset that it will be possible to deal with each and every case of perceptual variation in the same way. The Argument from Perceptual Variation is usually presented in such a way as to invite a unilateral response. The operative assumption is that the different ways in which an object’s colour appears as a result of variations in the perceptual conditions form a common kind: that variations consequent upon differences in viewing distance, background, illumination and the nature of the perceiving subject are merely sub-species of the same genus.¹⁴

Although the overall argumentative strategy is the same with respect to each kind of variation, however, the differences in colour appearance in these situations are generated by varying factors that are, at least on the face of it, quite heterogenous. Broadly speaking, the factors that affect perceived colour fall into two distinct categories: differences in environmental conditions and differences in perceiving subjects. The environmental differences themselves include variations the

¹³ We are interested in what are called *film* or *aperture* colours (see §6.3).

¹⁴ Berkeley’s use of the Argument from Perceptual Variation is wholly indiscriminate, applying it to all kinds of variation for all kinds of perceptual property. A more recent example of the tendency to treat cases of variation in colour perception alike is Cohen 2005. Calling it “The Master Argument”, Cohen sets out the Argument from Perceptual Variation before plugging into the general argument schema different kinds of variation in colour appearance, in each case arguing for a relationist theory of colour by rejecting the incompatibility claim, premiss (2).

viewing distance, the background against which an object is perceived and the illumination under which the observation occurs, which all appear to be very different kinds of factor. The differences on the subjective side are seemingly no less disparate. Colour perception varies not only across species, for instance, but within one and the same species. Even within the same species, variation is the result of very different kinds of factor: the natural ageing processes, genetic defects, cortical damage, minor physiological variations, and so on. Given the sheer diversity of the factors that affect perceived colour, we should not simply assume that it will be possible to deal with all cases of variation in the same way. Just because one kind of response is appropriate in one situation, there's no guarantee that it will be appropriate in another context.

Indeed, I will argue over the next three chapters that the different kinds of variation do indeed call for different kinds of response. In relation to (some) variations in perceived colour that are due to differences in viewing distance, for instance, I will argue that we should reject premiss (1) of the Argument from Perceptual Variation: the assumption that it is the very same object, and not just different parts of the same object, that appears to have the incompatible properties. Sometimes, as in the case of variations due to illumination and defective colour vision, I will argue that we should reject premiss (3) of the Argument from Perception Variation – that there is no non-arbitrary reason to prefer one set of viewing conditions over another. In response to variations in colour perception across species, I will argue that we need to reject premiss (2) – that the different colour appearances are incompatible. On still other occasions, I will suggest that the Argument from Variation actually tells us something very important about the limits of colour perception: there comes a point at which variation in colour perception forces us to consider questions about the acuity of our colour perception and delimit the extent to which our common sense beliefs about colours are veridical accordingly.

3. Distance and Background

Although the colour an object appears depends both on the viewing distance and the background against which it is perceived, in elucidating the notion of 'real'

colour I am concentrate on variations in illumination (§§3.4-5). This is because variations in perceived colour that are the result of variations in illumination are far more striking than the effects of either distance or background.

The most striking examples of the effects of viewing distance on perceived colour, for instance, are relatively easily dealt with. In the *Dialogues*, Berkeley mentions that “a microscope often discovers colours in an object different from those perceived by the unassisted sight”.¹⁵ A famous example, noted by amongst others Locke, is that a drop of blood, which appears to be uniformly red to the naked eye, appears under a microscope to be composed only of a “few Globules of Red, swimming in a pellucid Liquor”.¹⁶ The differences of appearance generated using a microscope are just the limiting case of a much more prevalent phenomenon. In his notebooks, for instance, Berkeley describes blue and yellow chequered squares that, receding into the distance, appear green.¹⁷ A variation on this theme concerns differently coloured threads that when woven together produce a garment that appears a third colour: in Austin’s version the threads are black and white and the garment grey, in Armstrong’s the threads are red and white and the garment pink, although clearly, many other combinations would also work.¹⁸ Pixelated colour arrays, such as those found in newspaper pictures, mosaics, pointillist paintings and television screens, all work on essentially the same principle: in the case of colour television screens, for instance, all the colours that you perceived are generated by cathode tubes that contain just red, green and blue phosphors.¹⁹

Striking though these examples are, however, they do not undermine the appearance-reality distinction that is a commitment of the naïve view that colours are mind-independent properties. At least as they are used by Berkeley, for instance, these examples function at best only as an implicit *reductio* of the distinction. Although viewing an object at different distances – at the limit with a microscope – generates different appearances, Berkeley himself suggests a non-arbitrary principle that allows us to choose between these conflicting appearances: that an object’s real colour is that which is “discovered by the most near and exact survey”. At least

¹⁵ 1713: 184.

¹⁶ 1690: II.xxiii.11.

¹⁷ 1707-8: 502.

¹⁸ See, for instance, Austin 1962: 83 and Armstrong 1969: 127.

¹⁹ For an overview of the different ways in which colours can be reproduced, see Hurvich 1981: 299-313.

taken at face value, Berkeley's argument therefore proves, not that there is no appearance-reality distinction, and hence that all colours are equally apparent, but only that an object's real colour is that colour which it appears to have when it is seen at the shortest possible viewing distance.

The implied *reductio* rests on the suppressed assumption that this way of drawing the appearance-reality distinction is unquestionably unacceptable: that *no* distinction would be preferable to a distinction drawn in this way. But even if we accept the argument up until this point, this further step is questionable. Acknowledging the possibility that our ordinary colour thought is to a greater or lesser extent erroneous is an occupational hazard of the naïvely realistic view that colours are mind-independent properties that are *there to be perceived*. To acknowledge the mind-independence of colour is just to acknowledge the possibility that the environmental and subjective conditions necessary for the veridical perception of colour might fail to hold. The naïve realist therefore has to be prepared to accept that in the worst case scenario many, if not all, of our ordinary colour ascriptions are false. Assuming for the sake of argument that an object's real colour is that which is discovered by the most near and exact survey, for instance, the naïve realist should concede the possibility that no medium-sized dry good is ever really coloured in the way that it appears to be, and that in fact the colours we ordinarily appear to perceive all vanish on closer inspection. The naïve realist should even concede the possibility that some of the colours we ordinarily perceive are never *really* instantiated at all. It is at least logically possible, as Armstrong suggests, that every pink surface will turn out on closer inspection to really be a mosaic of red and white pieces. Indeed, Berkeley uses the example of diminishing yellow and blue chequered squares to try to prove that green is 'compounded' in exactly this way.

Still, even if our ordinary colour experience were systematically false in this way, naïve realism about colour would not be a wholly unattractive theory. Nothing has been said, for instance, to imply that the colours objects are discovered to be on closer inspection would differ fundamentally *in kind* to the colours that they appear to be on first view. For instance, the examples used by Berkeley, Austin and Armstrong, in which colours that have a location within human colour space are juxtaposed to produce the appearance of a third colour that also has a location in human colour space, do nothing to support the claim that objects could have novel

colours that have no location in human colour space. At worst – if, say, pink or green turned out to be compound colours – the set of real colours would be subset of the set of apparent colours. But so long as the colours that we discover on closer inspection are determinates of the same determinable as the properties that we perceive at the macroscopic level, we at least know in general what colours are.²⁰

More to the point, however, these examples of perceptual variation do not anyway threaten the reality of the colours that we normally perceive. For the Argument from Perceptual Variation to work, the conflicting appearances identified in premiss (1) have to be appearances of *the very same thing*: it has to be the very same object that at one viewing distance appears to be one colour and at another appears to be another. The problem with these cases is that the appearances are not even appearances of the very same thing: it is not the very same thing that appears red and pellucid, blue and green, or red and white. Wholes can have properties that their individual parts lack. My coffee table can have a mass of 10kgs, for example, without the parts that constitute it being themselves 10kg: the table top might have a mass of 6kgs and the legs a mass of 4kgs. Similarly, my coffee table can be coffee table shaped without its proper parts also being coffee table shaped: the legs might be cylindrical and the top rectangular. It is no less counter-intuitive to suppose that an object can have a colour that its proper parts lack: for example, that a shirt can really be pink even though the threads out of which it is woven are themselves red and white.²¹

Not every case in which viewing distance affects perceived colour is a case in which different things – wholes and their individual parts – actually have different colours. For example, colours generally appear lighter and slightly more saturated at larger viewing distances than close up.²² As the viewing distance increases still further, objects begin to appear progressively bluer, an effect that is most closely associated with the perception of distant mountains and is best appreciated by

²⁰ This idea is exploited in corpuscularian science, which models the insensible microscopic bodies essential to natural explanation on the macroscopic bodies that we more normally perceive. As Descartes remarks, “No one who uses his reason will, I think, deny the advantage of using what happens in large bodies, as perceived by our senses, as a model for our ideas about what happens in tiny bodies which elude our senses merely because of their small size. This is much better than explaining matters by inventing all sorts of strange objects which have no resemblance to what is perceived by the senses”, 1644: IV.201. See §7.4.

²¹ As Hilbert suggests, colour predicates are not “dissective”: they are not satisfied by every part of every individual that satisfies the predicate, 1987: 35.

²² Sivik 1997: 184-5.

looking a succession of ridges that become gradually bluer as they recede into the distance.²³

But, these examples do not undermine the appearance-reality distinction either. The effect whereby objects appear blue at very large viewing distances, for instance, is caused by an atmospheric effect called ‘airlight’, which occurs when the light travelling from the object to our eye is scattered by intervening particles in the air. The mountain appears blue because these particles preferentially scatter short wavelength blue light.²⁴ In this case, there is a non-arbitrary reason to prefer one set of viewing conditions over another. The non-arbitrary reason to say that the mountains only *appear* blue at large viewing distances is that the light reaching the eye is modified by the intervening medium; it is distorted in transit. As I explain in more detail below, an object’s colour is intimately related to the way in which it modifies light (§3.4). Reducing the viewing distance gives you a better picture of the real colour of the mountain because it reduces the amount of atmospheric interference to the light reaching the eye, and so reduces the extent to which the object’s propensity to modify the incident light is masked. As such, premiss (3) of the Argument from Perceptual Variation, which requires that there be no non-arbitrary reason to prefer one set of viewing conditions over another, is false.

Generally speaking, if you want to know what colour an object really is, it is best to view the object at as short a distance as possible, such that it is still the object you perceived and not the distinct parts that compose the object: you need to be as close as possible, but not so close that you cannot still see the wood for the trees. This not only reduces the effects of atmospheric interference, but it optimises the resolving power of the eye which is better able to extract information about objects in its environment the greater the area of the visual field those objects occupy. A good rule of thumb, given the necessary connection between colour and shape, is that the optimal viewing distance for determining an object’s colour is also the best distance at which to determine its shape. If you’re too far away to reliably tell what shape something is, then you’re probably too far away to reliably see what colour it is as well.

²³ For an illustration of this, see Lynch and Livingston’s visually stunning *Color and Light in Nature*, 2001: 28.

²⁴ See Minnaert 1954: 239, Lynch and Livingston 2001: 29.

Obviously this is rather vague. But then perhaps this is just what we should expect. For one thing, *the* optimal distance at which to perceive an object's colour will vary from object to object, depending upon the size, and more general nature, of the object. Besides, as I argue in more detail below, the visual system is not naturally geared towards grounding very precise colour ascriptions. For most purposes, it is sufficient to know what colour an object is just at the level of determinable colours like yellow, green or blue (for more details, see §5.3). Variation in perceived colour that is the result of variation in viewing distance is just too slight to alter the coarse-grained colour judgements that we make about objects. An object that looks broadly speaking red at a viewing distance of 0.5 metres will still look broadly speaking red at a viewing distance of 80 metres. So long as we are obviously neither too close to, nor too far away from the object, then at least our coarse-grained colour perception will be veridical.

For a similar reason, variation in perceived colour that is the result of simultaneous colour contrast is no more problematic. It has long been known in the artistic community that contrast affects perceived colour. In the early sixteenth century, for instance, Leonardo da Vinci noted that “black clothes make a face appear whiter than it is, white clothes darker, yellow clothes bring out the colours in it, and red clothes make it paler”.²⁵ Later, in the first half of the nineteenth century, Delacroix boasted that he could even reproduce the radiant flesh of Venus from mud, if has was allowed suitable contrasts.²⁶ Building on Goethe's famous discussion, the phenomenon of colour contrast was extensively studied by Chevreul, who, as designer of dyes at the Gobelin tapestry factory in Paris, had to convince weavers of calicos with red and black patterns that the green tint the black appeared to have was the result of contrast effects, and not inferior quality dye.²⁷

Contrast affects are generally most pronounced for the so-called pure contrast colours, black, white, grey and brown. Simultaneous contrast involving the achromatic colours is illustrated in Figure 3.1: in each case the inner square is the same shade of grey, but appears different depending upon the colour of the

²⁵ Minnaert 1954: 134.

²⁶ Hardin 1988: 49.

²⁷ Goethe 1810: §§47-61, Chevreul 1839. Goethe mentions, for example, that “If a green paper is seen through striped or flowered muslin, the stripes or flowers will appear reddish. A grey building seen through green palisades appears in the like manner reddish... Objects seen through an opening in a red or green curtain appear to wear the opposite hue” (§57).

background against which it is seen. Striking contrast effects for the chromatic colours can, however, also be generated. Whittle, for instance, has recently devised an set up in which patches spanning a limited chromatic interval – such as blue to violet, or red to orange – can be made to appear all the main colours of the hue circle by varying their background.²⁸

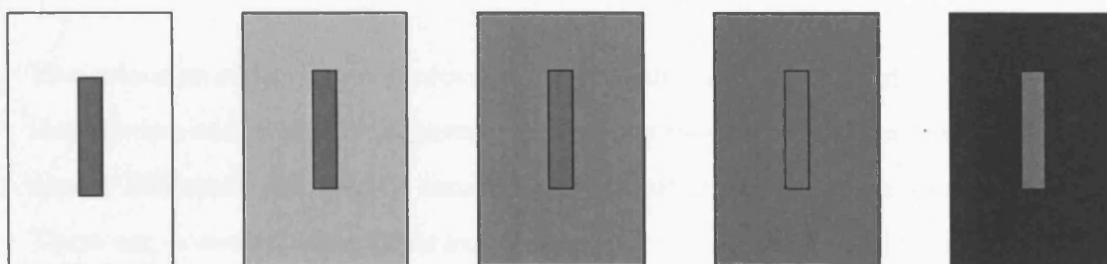


Figure 3.1: Achromatic Simultaneous Contrast Effect

The inner boxes are the same shade of grey, but the grey boxes on the left, seen against the lighter backgrounds, appear darker than the grey boxes on the right, seen against the darker backgrounds.

Outside of the lab or artist's studio, however, differences in perceived colour generated by simultaneous contrast generally go unnoticed. Even Berkeley, who was obsessed with perceptual variation, does not include background amongst the litany of factors that he mentions affects perceived colour. Part of the reason why we don't notice contrast effects is because of the perceptual constancy of colour: we perceive an object's colour to remain constant throughout changes in the background against which it is perceived. Part of the reason why we don't generally notice contrast effects, however, is just that they are normally far less pronounced than variations in perceived colour that are the result of varying the illumination; throughout which colours are, after all, also perceived to remain constant. The startling contrast effects that Whittle generates, for instance, in which colours from the hue circle can be made to appear any other colour on the hue circle, require a very convoluted set up. The more common place examples of contrast, on the other hand, are not nearly so striking, and do not affect the coarse-grained, determinable, colour judgments that we make. In the example presented in Figure 3.1, for instance, although the grey boxes appear slightly different in each case, we would not hesitate to say that any of them were, broadly speaking, grey. Standard textbook versions of chromatic contrast are even less striking. As with variations in distance,

²⁸ Whittle 2003.

variations in background therefore do not generally affect the truth of the coarse-grained colour judgements that our visual system is geared towards making. An object will appear to be the determinable colour that it really is against pretty much any background.

4. In Defence of Natural Daylight

The colour an object appears varies much more dramatically depending upon the illumination under which it is perceived. Berkeley mentions that “the same bodies appear differently coloured by candlelight, from what they do in the open day”.²⁹ There are, however, many other examples of the way in which the illumination affects perceived colour that we can add to this. Consider the effect on perceived colour of shining a blue light on a white wall. Or – varying the colour of the illumination less noticeably – consider the effect on perceived colour of turning on a incandescent desk lamp in a room that is already lit by natural daylight, or the colour an item of clothing appears under the fluorescent strip lighting of a shop changing room.³⁰ Do these kinds of variation in perceived colour suffice to show that objects are not ‘really’ coloured at all?

One response in the face of this kind of variation is to deny premiss (2) of the Argument from Perceptual Variation, which states that the colours an object appears under different illuminations are incompatible. This response is most naturally associated with the view that an object’s colour changes as the illumination changes, which is itself most naturally associated with the view that colours are *relations* between objects, subjects and illuminants, relations that change as their constituent relata change. Changing the illumination under which an object is seen is not at all like grinding it with a pestle and mortar or painting its surface. Light is non-invasive in a way that pestles and paint are not. Needless to say there are exceptions: some objects, like photographic paper and clouds, are especially

²⁹ 1713: 186.

³⁰ Although lights like these are often described as ‘white’, they actually have a slight colouration. Incandescent tungsten lights, for instance, typically appear a yellowish-white, whereas fluorescent lights usually appear a slightly bluish-white. A simple experiment illustrates this (Hurvich 1981: 41). Fold a piece of white paper and place it like an open book on a table, such that one side is illuminated by daylight and the other by an artificial light source. If you look at the edge of the paper through a tube (or rolled up piece of paper) a difference in the colour of the two light sources should be easily discernible. For a discussion of variations in ‘white’ light, see Henderson 1977: 244-57.

sensitive to changes in light, whilst most other objects are affected by very intense light, as from a laser, or prolonged exposure to less intense light, as when sunlight bleaches the colours of objects in a shop window. Generally speaking, however, light is unable to bring about a change in the material constitution of objects; certainly not at the rate that it would need to for an object's colour to change throughout changes in the illumination. It therefore only makes sense to think of colours changing with variations in the illumination if we think of colours as relations between objects, subjects and illuminants. This is precisely the point of Locke's porphyry example: Locke argues that unless we think of colours as relations, then we cannot make sense of the idea – which Locke regards as simply self-evident – that objects lose their colours in the dark (§1.2). It is also the point that Evans makes in asking us to try to conceive of colours existing in the dark in the first place: what is it we conceive, Evans asks, when we think of colours existing in the dark, if not how the object would look in a situation in which subject, object and environmental conditions co-exist (§2.1)?³¹

Notwithstanding Austin's observation that it is the negative use of 'real' that generally 'wears the trousers', it makes some sense to say that relationism is at least a realist theory of colour: that objects *really* are all the colours that, under different illuminants, they appear to be. Still, in the first instance, the plausibility of relationism as a response to the Argument from Perceptual Variation depends upon the extent to which relationism coheres with our ordinary thought about colour more generally: insofar as the motivation for resisting the Argument from Perceptual Variation is to avoid convicting common sense of widespread error, we should prefer a response to this problem that does not itself suggest that our ordinary colour thought is systematically mistaken. As we have already seen, however, if relationism is true, then it is true at the expense of common sense beliefs about colour; it is, for instance, inconsistent with the common sense belief that colours are mind-independent properties that persist through variations in the conditions necessary for their perception. Mistaking a relational property for a non-relational property is no doubt a less serious offence than ascribing a property to an

³¹ For a more recent defence of relationism in response to illumination-dependent variation, see Cohen 2005. Jackson and Pargetter combine relationism with physicalism, suggesting that "The blue light may actually change the relevant physical properties of the wall's surface, in which case the right thing to say is that the wall under blue light *is* blue. The light actually *turns* the wall from white to blue", 1987: 73. See also Campbell 1969 and McLaughlin 2003.

object that has nothing even remotely resembling that property. But it is still a mistake. All else being equal, we should therefore try to avoid the relationist response to the Argument from Perceptual Variation.

Consistent with the view that colours are genuinely mind-independent properties, it is still theoretically possible to deny premiss (2) of the Argument from Perceptual Variation. According to this view, defended by amongst others the early twentieth century New Realists (or New Naturalists), objects really have as many colours as there are colours they appear to be, all of them robustly mind-independent.³² I will suggest later that something like this is appropriate in response to inter-species variation in colour perception (§4.2). In relation to differences in perceived colour that are the result of varying the illumination under which an object is perceived, however, this response is also less than ideal.

Although it is consistent with the general view that colours are mind-independent properties, it is not consistent with the *naïve* view that colours are mind-independent. For instance, we do not ordinarily think that when we hold an object up to the light, or illuminate it with a new light source, we thereby perceive different (albeit mind-independent) properties of the object. We think instead that objects have only a limited stock of colours that in non-standard conditions appear other than they really are. Indeed, colours could not play the role that they play in grounding our conception of the mind-independent existence of material substance if this were not the case. Sameness or difference of colour, for instance, is one of the principles in virtue of which we determine sameness or difference of material substance. But our judgements about sameness or difference of colour are not restricted to situations in which the object is illuminated by the very same kind of light, as they would have to be if New Realism was true of our common sense thought about colour.

Moreover, as far as revisionary theories of colour go, New Realism is not even especially attractive. It offends against even the weakest sense of parsimony. As Barnes complains, according to these “wilder excesses of realism”:

³² See, for instance, Nunn 1909-10, Holt *et al* 1912, and for a recent discussion, Smith 2002: 29-31. Smith also lists as sympathetic to the New Realist position Epicurus and Sartre.

the world...[takes] on the appearance of a great museum in which a few of the contents were operative beings but the vast majority were exhibits only, ready to be produced on the appropriate occasion, but possessed of no other ground of existence.³³

Rather than question premiss (2) of the Argument from Perceptual Variation, a much more promising strategy is therefore to look more closely at premiss (3). The truth of premiss (3) requires that there be no non-arbitrary reason to privilege one set of illumination conditions as revelatory of an object's real colour over any other. But is this right? Certainly as a matter of descriptive fact, we tend to think that the real colours of objects are actually revealed in natural daylight. The reason why we say that 'white walls appear blue under blue light', for example, is that we do not think that the walls appear as they really are when so illuminated: 'appear' implies a contrast with the way things really are, underscored by the description of the walls as '*white* walls', and not just 'walls'. Similarly, if we like the colour of a piece of clothing under the fluorescent light of a shop changing room but not in broad daylight, we do not think that natural daylight is deceptive. We think that the garment does not appear the rather unpleasant colour it really is under the artificial illumination in the shop. But can we justify this preference? Is there any non-arbitrary reason to suppose that natural daylight reveals the real colours of objects?

A shallow explanation of our preference for natural daylight is that natural daylight happens to be the statistically normal illuminant under which we perceive colours. This explanation, however, depends too heavily on the contingencies of our situation. If fluorescent strip lighting became the statistically normal illuminant under which to perceive colours, this would not thereby become the illuminant under which the real colours of objects were revealed. To suppose that it would undermines any robust sense in which colours are non-relational, mind-independent properties. If colours are mind-independent properties then they must be as they are independent of both the subjects that perceive them and the conditions under which they are perceived: changing either of these variables cannot be thought to bring about a change in an object's colour.

Neither does simply rigidifying the description of viewing conditions to statistically normal viewing conditions as they actually are solve this problem.³⁴

³³ 1944-5: 144.

Rigidification is supposed to help respect the intuition that the colours of objects would not really change if the prevailing conditions changed. The ‘really’ here, however, carries no metaphysical force, unless there is some reason to privilege actual normal conditions over and above the fact that they are the statistically normal conditions hereabouts: otherwise, ‘really’ is just an honorific that marks the existence of a convention to arbitrarily prefer one set of conditions over any other. For instance, suppose that there is a world exactly alike ours, inhabited by people exactly alike ourselves, but where the statistically normal illumination is fluorescent strip lighting. Considering the possibility that the prevailing illumination might have been different, the philosophers in this world assure themselves that if, for instance, natural daylight had been the statistically normal illumination, things would not have been differently coloured because objects really are the colours they appear under what is actually the statistically normal illuminant: in this world, fluorescent strip lighting. If the rigidification strategy is valid, then it should be valid for our counterparts on this world. And now there will be as many real colours as there are conditions that can be used to fix the extension of the term ‘real colour’. But this just seems wrong. It seems wrong to say that there is any sense in which tomatoes would *really* be orange in the fluorescent world, even if this was how they normally appeared. There has to be something about the normal conditions in a world that confers on them a special advantage. We therefore need a deeper explanation of our *de facto* preference for natural daylight.

With this in mind, we need to consider in more detail the relationship between colour and light. It has long been known that there is a close relationship between colours and the way in which objects reflect light. Material objects reflect different amounts of light from every part of the visible electromagnetic spectrum: the region of the electromagnetic spectrum between 400 and 700 nanometres (nms), light from which appears violet at its lower end, red at its higher end, and passes through the colours of the rainbow – blue, green, yellow and orange – in between. The relative proportion of the incident light that an object reflects at each spectral wavelength can be represented graphically, as in Figure 3.2, by a *surface reflectance profile*.

³⁴ This is the standard dispositionalist manoeuvre. See, for instance, Peacocke 1983, Johnston 1992: 144, Wright 1992: 114.

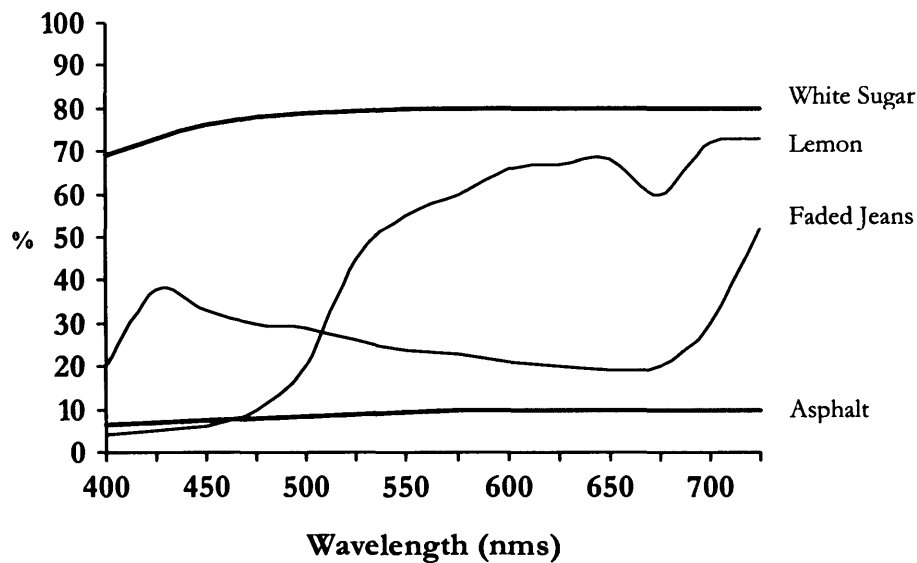


Figure 3.2: Sample Surface Reflectance Profiles
Source: Byrne and Hilbert 2003.

As I discuss in more detail later, the exact nature of the relationship between colours and surface reflectance properties is not entirely straightforward. Colours cannot simply be identical with reflectances because reflectances cut too fine: objects that differ in their reflectance can, and indeed often do, appear identical in colour (at least in specific circumstances), a phenomenon known as *metamerism* (§6.3). Although metamerism blocks the identification of colours with individual reflectances, however, it is generally speaking common ground amongst those who accept the mind-independence of colour that there is some close relationship between colours and reflectances. Whether they identify colours either with reflectance-types or distinct *sui generis* properties, almost all parties agree that reflectances at least *determine* colours; or to put it round the other way, that colours *supervene* on reflectances: that there can be no difference in colour without a difference in reflectance (§7.1).³⁵

The important point here is that the supervenience of colours on reflectances suggests a solution to the Argument from Perceptual Variation. The light that an object reflects is a function of the composition of the light that strikes it (the incident light) and the object's surface reflectance property. What this

³⁵ In advance, I should mention that what we want here is specifically necessary (or strong) supervenience. For more details, and a defence of the necessary supervenience of colours on reflectances, see Chapter 7.

effectively means is that the light that reaches the eye from material objects carries information about the reflective behaviour of those bodies: it encodes information about how objects modify the incident light. Given the supervenience of colours on reflectances, it follows that any conditions under which the light reaching the eye carries full and accurate information about the object's reflectance will be conditions under which the nature of that object's colour is revealed. There are, in particular, two conditions that the illumination must satisfy.

First, the light reaching the eye must carry information about the object's reflective behaviour at every visible spectral wavelength. Consider, for instance, the contrast between natural daylight and monochromatic light: light composed of a single spectral wavelength (or else strictly limited range of spectral wavelengths, up to no more than about 10nms). The reason why monochromatic light does not accurately reveal the colours of objects is that it conveys only partial information about their reflective behaviour. Because the light striking the object is composed of light from a strictly limited range of spectral wavelengths, it only encodes information about the reflective behaviour of the object at those wavelengths. But as an object's reflective behaviour is much more extensive than this, the light that reaches the eye carries only partial information as to its reflectance: the eye receives no information about how the object reflects light in any other part of the visible spectrum. The information about the object's reflectance that the light carries therefore underdetermines its nature.

At 510nms, for instance, the yellow lemon and blue faded jeans whose reflectances are illustrated in Figure 3.2 reflect the same proportion of the incident light: roughly 30%. This means that illuminated by a 510nm monochromatic green light, the information that the reflected light reaching the eye encodes doesn't put us in a position to distinguish between these objects: it doesn't tell us whether the object's reflective behaviour across the rest of the visible spectrum is more like that of the lemon or the jeans. But there is clearly a very big difference in this, and dependent upon it, a very big difference in the colours these objects are: indeed, blue and yellow lie on opposite sides of the human hue circle.

Natural daylight differs from monochromatic light insofar as it is a *continuous* illuminant: it is composed of light of a broadband spectral wavelength, and not just light of a specific wavelength. Therefore, the information about an object's reflective

behaviour that it conveys is not partial in the way that the information conveyed by a monochromatic light is. More than this, the broadband wavelength light of which natural daylight is composed is not just continuous, but spans the entire visible spectrum: it is *entire spectrum light*. It is for this reason that when we pass natural daylight through a prism the full gamut of spectral colours can be seen. The refractive indices of the different wavelength lights that compose daylight differ: short wavelength light is refracted through a larger angle than long wavelength light, so passing natural daylight through a prism splits it into its component parts, from short wavelength ‘violet’ light of 400nms, through the different colours of the rainbow – green (520nms), yellow (570nms) and orange (600nms) – to long wavelength ‘red’ light of 700nms.

Not all continuous illuminants are entire spectrum lights. Part of the reason why an object’s colour appears different in candlelight – one of the facts to which Berkeley draws our attention – is that although candles emit light continuously, they do so only in the higher end of the visible spectrum: candlelight is composed exclusively of light with a wavelength of no less than 550nms, light that is phenomenally red-orange (see Figure 3.6). Hence, white things, for instance, which reflect light in equal proportion across the visible spectrum, assume a red glow in candlelight because they reflect almost entirely the phenomenally red-orange light that strikes them. More generally, the colours of red and yellow things, which tend to reflect more long wavelength light than short wavelength light, appear more vivid, whereas the colours of blue and green things, which tend to reflect more light in the lower regions of the visible spectrum, appear duller.

Entire spectrum light is clearly preferable to any kind of light – continuous or otherwise – that is not composed of light from every part of the visible spectrum. If there is any part of the visible spectrum that the light striking the object does not contain, then it cannot convey information about the reflective behaviour of the object at that wavelength. The information about the object’s reflective behaviour that it encodes is merely partial: it can fully reveal neither the object’s reflectance, nor the colour that this reflectance determines.

It is not just that natural daylight is continuous across the entire visible spectrum that singles it out as revelatory of the real colours of objects, however. Natural daylight is not unique in respect of being composed of light of each and

every spectral wavelength. Many light sources emit light at each part of the visible spectrum. Like material objects, entire spectrum light sources behave differently at different spectral wavelengths. Just as the different proportions of the incident light that material objects reflect at each spectral wavelength can be represented by their surface reflectance profile, we can represent the different proportions of light that a light source emits at each spectral wavelength (in an arbitrary unit) by the light source's *spectral power distribution profile*, as Figures 3.3 and 3.4 illustrate.

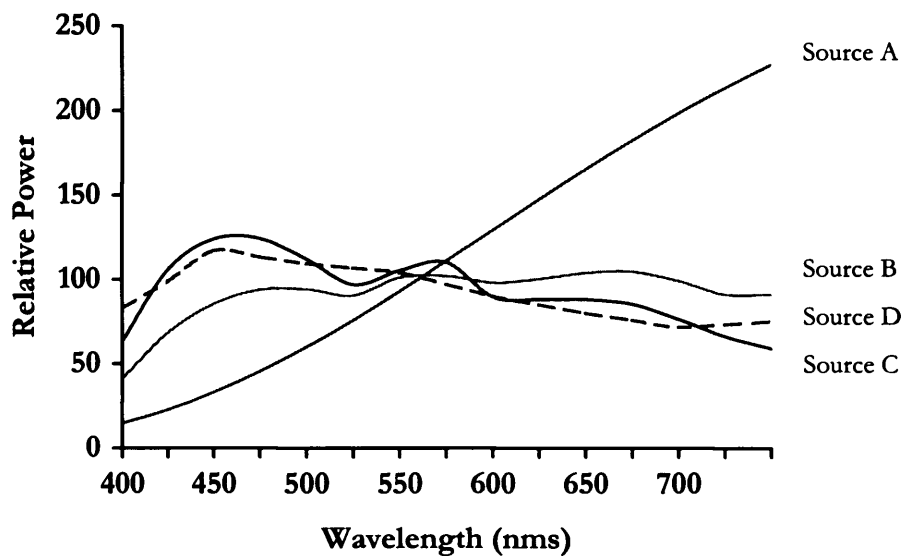


Figure 3.3 Spectral Power Distributions of C.I.E. Standard Illuminants

Source A represents the spectral power distribution of an incandescent tungsten lamp; Source B direct sunlight at noon on a clear day; Source C skylight on an overcast day; Source D daylight on a clear day. Source: Wyszecki and Stiles 1967.

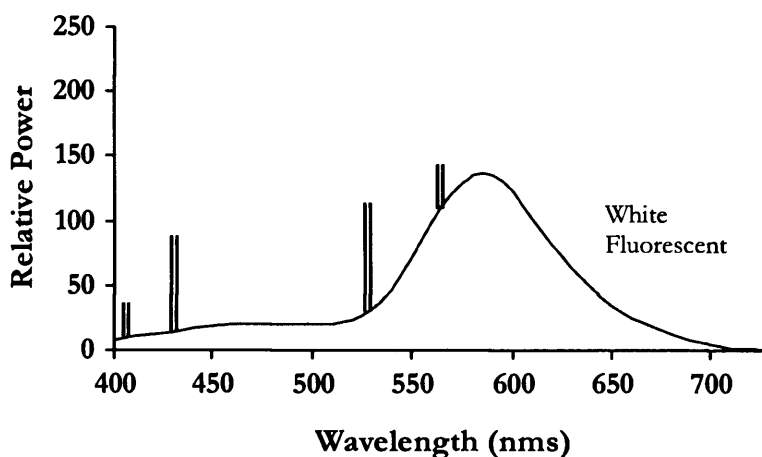


Figure 3.4: The Spectral Power Distribution White Fluorescent Light

In addition to a more or less intense continuous spectral emission, fluorescent lights have a number of line spectra, represented by the sharp peaks. Source: Wyszecki and Stiles 1967.

Even amongst illuminants that emit light in every part of the visible spectrum, however, natural daylight is still the gold standard because it is roughly speaking *equal energy light*: its spectral power distribution is to all intents and purposes flat across the visible spectrum. For an illuminant to carry full and accurate information about the way in which objects reflect light, the reflected light cannot encode disproportionately more information about how objects reflect light in one part of the spectrum over any other. Any differences in the spectral composition of the light that reaches the eye have to reflect the fact that an object reflects light differently in different parts of the visible spectrum; we don't want differences in the composition of the reflected light to be a function of differences in the composition of the light incident upon the object in the first place.

Consider, by way of illustration, the difference between natural daylight and fluorescent illumination. Fluorescent lights are relatively efficient illuminants, emitting most of their energy in the visible part of the electromagnetic spectrum; in contrast, incandescent tungsten lamps, for instance, get very hot when they are used for extended periods of time because they emit as much, if not more, energy in the infra-red part of the spectrum (over 700nm) as they do in the visible part, as Figure 3.6 illustrates. Fluorescent lamps do not accurately reveal the real colours of objects, however, because like other electrical discharge lamps – illuminants in which radiant energy is produced by passing an electric current through a gas or vapour – the emission spectra for fluorescent lights contain sharp peaks and troughs. In the case of fluorescent lights these peaks are at least fairly evenly spread across the spectrum, thereby giving a reasonably representative sample of an object's reflective behaviour. Still, the fact that there are these disparities in the spectral power distribution of fluorescent lamps means that reflected fluorescent light carries only distorted information about an object's reflectance.

The fluorescent light source whose spectral power distribution is represented in Figure 3.4, for instance, emits most light in the yellow, green and blue regions of the spectrum, but very little in the high end of the red part of the visible spectrum between 650 and 700nm. Consequently, the information that the light can encode about an object's reflective behaviour in this part of the spectrum is decidedly limited.

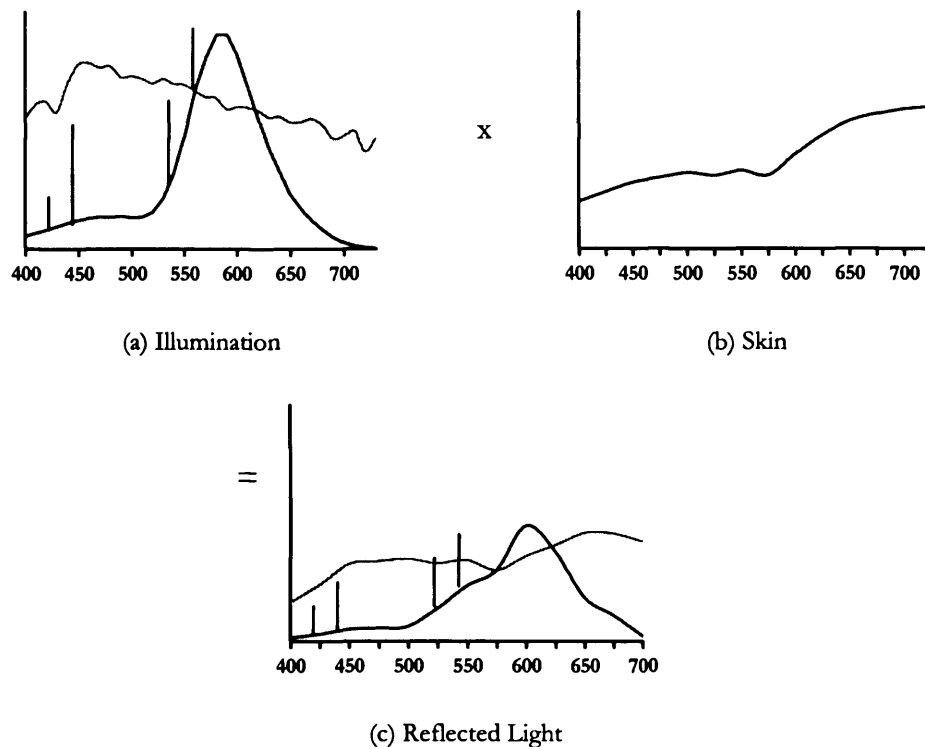


Figure 3.5: Skin under Different Illuminations

(a) represents the spectral power distributions of a standard fluorescent light (in black) and natural daylight, D_{65} (in grey). (b) represents the surface reflectance profile of pale skin. (c) represents the spectral power distribution of the light reflected by the skin under these illuminants. The light an object reflects at a wavelength is a function of the quantity of light that strikes it and the proportion of this light that it reflects. Source: Williamson and Cummins 1983: 35.

Suppose that we are perceiving pale skin under this fluorescent lamp. Skin reflects a higher proportion of the incident light in the long wavelength region of the spectrum than in the lower region, as Figure 3.5b illustrates. Because the fluorescent lamp emits comparatively little light in this part of the spectrum in the first place, the spectral power distribution of the light that reaches the eye is skewed in favour of those wavelengths where the illuminant's emission is greater to start with, as Figure 3.5c illustrates. The result is that the fluorescent light does not carry accurate information about how the skin reflects light in the top end of the visible spectrum, between 650-700nm. Consequently under this illumination, the skin appears less red than it really is. This is the reason why you often appear pale and tired under fluorescent light. Under natural daylight, in contrast, differences across the spectrum in the power distribution of the light reaching the eye mirror differences in the way the skin reflects light in different parts of the visible spectrum: the skin's reflectance

profile and the spectral power distribution profile of the reflected light are roughly isomorphic. This means that natural daylight carries full and accurate information about how the object reflects the incident light. As a result its colour, which supervenes on its reflectance, is thereby revealed.³⁶

5. The Limits of Natural Daylight

I have argued so far that where differences in perceived colour are generated by varying the illumination, premiss (3) of the version of the Argument from Perceptual Variation is false. Assuming the supervenience of colours on reflectances, the real colours of objects are revealed in those conditions under which full and accurate information about their reflectances reaches the eye. Natural daylight therefore reveals the real colours of objects because natural daylight is roughly speaking equal energy light, that is continuous across the visible spectrum. Three qualifications to this defence of natural daylight, however, need to be made.

The *first* qualification is that the spectral power distribution of C.I.E. illuminant D (or D₆₅) only represents one of the phases of natural daylight. Because the nature of the light that reaches objects on the ground varies constantly, there is not actually any single spectral power distribution profile that describes natural daylight as such. Consider, for instance, the difference between daylight on a heavily overcast and lightly overcast day; when the sun goes behind a cloud in an otherwise blue sky and when there is not a cloud in sight; the direct illumination of the sun at noon and the red light of the sun at dusk.

We can be more specific about differences in the phases of natural daylight by describing them in terms of their *colour temperature*. A light can be described in terms of a colour temperature if its spectral power distribution roughly approximates to the spectral power distribution of the light emitted by a “black body” – an ideal body which emits the maximum possible amount of electromagnetic radiation, and absorbs all the incident light that strikes it – at a

³⁶ The light reaching the eye from the scene as a whole may encode enough information for the eye to determine the real colours of objects even in less than ideal conditions. If the eye can estimate the spectral composition of the incident light then it can often discount variations in the spectral power distribution of the reflected light that are not a function of the way material objects reflect that light. This, roughly speaking, is how constancy is achieved. Note, however, this is not a situation in which the illumination simply *reveals* the real colour of the object, as it requires extra work on the part of the visual system.

specific temperature. Excluding monochromatic lights, most light sources can be described in terms of their colour temperature: candles, for instance, have a colour temperature of approximately 1900K, sodium street lamps a colour temperature of 2100K, incandescent tungsten lamps a colour temperature of around 2800K, and fluorescent lamps a colour temperature of anywhere between 3000-7500K, depending on their constitution. Generally speaking, the light that black bodies emit shifts towards shorter wavelengths as their temperature increases. At around 800 degrees Kelvin (K), black bodies begin to emit light in the long wavelength region of the visible spectrum, thereby appearing red. They subsequently emit a higher proportion of light at lower wavelengths as they become hotter, appearing orange at around 2000K, yellow at 3000K, white at 6000K and blue as their temperature increases to 10000K, as Figure 3.6 illustrates.

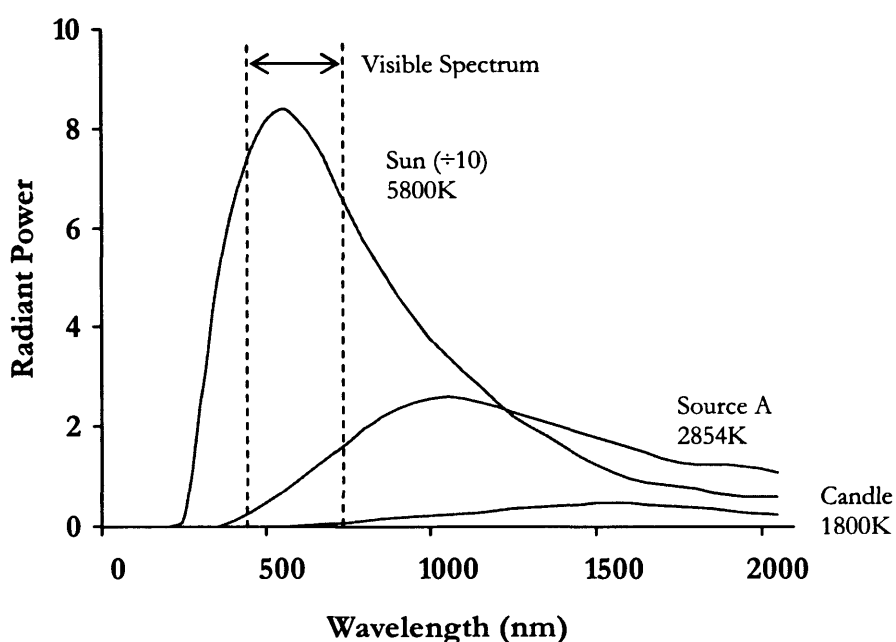


Figure 3.6 Black Body Radiation

Emission spectra for various black bodies. Values for the sun have been reduced by a factor of ten. Radiant power is measured in 10^3 watts per square metre of surface per nanometre interval. Source: Williamson and Cummins 1983: 197.

Differences in colour temperature help to bring out differences in the phases of natural daylight. The colour temperature of direct sunlight at noon, for instance, is around 5000K, signifying that its spectral power distribution is shifted slightly towards higher visible spectral wavelengths, and so appears slightly yellowish. This

colour temperature decreases as the sun moves closer to the horizon: at an altitude of 10° it is roughly 4000K, reducing to 2000K at sunset, reflecting the fact that as the sun moves closer to the horizon, the balance of the spectral power distribution of sunlight shifts towards the long wavelength, phenomenally red, region of the visible spectrum. The light on an lightly overcast sky ('north daylight') has a colour temperature of between 6500-7500K, reflecting the fact that it contains a greater proportion of short wavelength, phenomenally blue, light. Skylight – light from the sky, with no direct sunlight – in contrast, has a temperature of over 12000K, and as such is predominantly blue light.³⁷

These variations in natural light are caused by atmospheric interference, the most prevalent of which is *Rayleigh scattering*, whereby small particles in the atmosphere – such as air molecules, dust and water particles, volcanic ash, and pollution – more efficiently scatter from the sun's beam shorter wavelength blue light than longer wavelength red light: it is for this reason that the sky generally appears blue.³⁸ Direct sunlight has a relatively low colour temperature – the balance of its spectral power distribution is shifted towards the higher end of the visible spectrum – because the short wavelength light that the sun's radiation contains is more effectively scattered from the sun's beam by small particles in the atmosphere. The direct sunlight represented by the C.I.E.'s standard illuminant B, for instance, has a colour temperature of just 4874K (Figure 3.3). This colour temperature reduces still further when the sun is closer to the horizon, after sunrise and before sunset, as the amount of air that the sun's light has to pass through increases: when directly overhead the light from the sun has to pass through a smaller amount of air, and so is less subject to atmospheric distortion, than when it is nearer the horizon and, due to the curvature of the earth, travels through a much larger body of air, as Figure 3.7 illustrates. The progressive reddening of the sun is still more dramatic in

³⁷ This list of colour temperatures is pieced together from a number of sources, including Henderson 1977: *passim*, and Williamson and Cummins 1983: 216 and *passim*. It should be stressed that colour temperatures do not describe the actual temperatures of the source. A lamp can have a colour temperature of 6500K (6227°C) but be cool enough to touch. Colour temperature describes the nature of the light that a source emits *in relation* to the temperature of the black body that emits a similar kind of light. For more details, see Williamson and Cummins 1983: Chapter 7, esp. 193-201.

³⁸ Particles in the atmosphere also absorb the light from the sun. As well as absorbing energy from the potentially harmful ultra-violet part of the electromagnetic spectrum, ozone, for instance, absorbs heavily in the lower end – in the blue and green regions – of the visible spectrum; Lynch and Livingston 2001: 31.

summer, when there is less rain and consequently more particles in the air, and in built up areas, where there is much more pollution in the atmosphere.³⁹

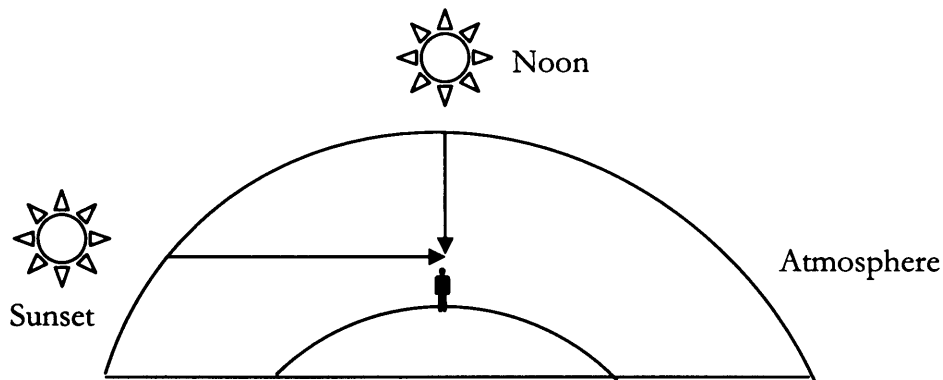


Figure 3.7 Distances Travelled by Sunlight

Comparison of the distance travelled through the atmosphere by sunlight at noon and sunset. Source: Lynch and Livingston 2001.

Of the phases of direct sunlight, the midday sun best reveals the real colours of objects because it is at midday that the sun's light most closely approximates to true equal energy light, light with a colour temperature of around 6000K. Still, direct sunlight is not the ideal illuminant under which to perceive an object's real colour. Because proportionally more of the short wavelength blue light has already been scattered by the particles in the atmosphere, the sun's light is of itself slightly too yellow. If a scene is illuminated only by direct midday sunlight – for instance, if light is only admitted into the scene by a small opening in a cave or canopy – the balance of the spectral power distribution of the light is shifted towards the higher end of the spectrum, affecting the colours that objects in the scene appear accordingly. Eliminating direct sunlight from the scene has the converse effect. If the direct sunlight on an otherwise clear day is blocked – by a tree or a lone cloud – the objects in the perceptual scene are illuminated instead by skylight. Because of the effects of atmospheric scattering, skylight contains a high proportion of short wavelength blue light, giving it a colour temperature that is at least double the colour

³⁹ Lynch and Livingston 2001: 31.

temperature of equal energy white light. Consequently, in skylight, colours appear bluer than they really are.⁴⁰

The light on a lightly overcast day ('north daylight'), when there is neither direct sunlight nor skylight, comes closer to the equal energy ideal. Indeed, the instructions with the most widely used colour atlas – *The Munsell Book of Color* – specify that its coloured chips should be viewed in either north daylight or its artificial equivalent, 'scientific daylight' with a colour temperature of 6500-7500K. There are certain practical considerations that favour this choice of illuminant. Munsell was himself a painter, and north daylight tends to be the preferred illuminant of painters because it minimises the problems caused by cast shadows. It is easier to paint naturally illuminated scenes on overcast days because objects do not cast strong shadows: paintings can take many hours to complete, during which time the shadows in a scene will have changed considerably. Even though it has since moved away from its artistic roots somewhat, at least part of the reason why the Munsell system of colour classification still uses north daylight is that good artificial approximations to this light are widely available. D₆₅ – the C.I.E.'s fourth standard illuminant – is sometimes called an illuminant, rather than a light source, because of the difficulties associated with its physical realisation.⁴¹ Clearly it would be impractical to require people to only use the *Munsell Book of Color* for very precise purposes at around noon on clear days: it has to be possible to emulate this illumination at will.⁴²

When it comes to revealing the real colours of objects, however, north daylight is still not perfect. The north daylight represented by the C.I.E.'s standard illuminant C, for instance, has a colour temperature of 6774K, with a peak in the short wavelength end of the visible spectrum – between about 440-490nm, the region that looks blue to blue-green – to match. The culprit, once again, is atmospheric scattering. Clouds are predominantly composed of larger water particles

⁴⁰ The examples come from Shepard 1992: 511. Part of the reason why shadows sometimes appear blue is that the area in shadow, in the absence of direct sunlight, reflects the predominantly blue skylight. See Hardin 1988: 50-1.

⁴¹ Henderson 1977: 279, 289-90.

⁴² The preferred illumination in the graphic arts industry, in contrast, is light with a colour temperature of around 5000K (sometimes called D₅₀). The reason for this is that the products that graphic artists produce are seen under a variety of different illuminations with different colour temperatures. By picking an illuminant with a colour temperature that is intermediate between those of the more common illuminants, it is possible to reduce striking instances of metamerism, whereby objects that colour match under one illumination look very different in colour under another. See Henderson 1977: 290-2.

than those that cause the generally blue appearance of the sky. Unlike smaller particles, larger particles scatter all light equally: this is the reason why clouds generally look white. Light cloud cover therefore dramatically reduces the Rayleigh scattering that occurs on clear days. But it does not eliminate it entirely. It is still a bit too blue.

Natural daylight which is a *combination* of direct sunlight and skylight – represented by the spectral power distribution of the C.I.E.’s fourth standard illuminant, D₆₅ – is much better in this respect. Generally speaking, the effect of the slightly yellow sunlight cancels out the effect of the bluer skylight, the net result being that this phase of daylight is, to all intents and purposes, equal energy light.

The final two qualifications to the defence of natural daylight concern important limitations to the revelatory powers of even this illuminant. The *second* qualification is that natural daylight is only revelatory of the colours of reflective (and more generally light-modificative) objects. In response to the suggestion that an object’s ‘real’ colour is the colour that it looks to be to a normal observer in conditions of normal or standard illumination, for instance, Austin objects that there are a number of coloured things that this does not cover. What is the real colour of a bioluminescent fish that appears vividly multi-coloured at a depth of a thousand feet? Or what is the real colour of the sky, the sun or the moon: “We say that the sun in the evening sometimes looks red – well, what colour is it *really*? What are the ‘conditions of standard illumination’ for the sun?”.⁴³ With reference to this discussion, Hardin adds to this list stars and neon tubes, using the parenthetical rhetorical question, “Do some objects have their own special ‘standard conditions’ for viewing?”, to imply that he regards the project of specifying standard conditions with sufficient generality futile.⁴⁴

This pessimism, however, is unfounded. For one thing, the class of light-modifying bodies is large enough, and of sufficient importance to us, for it to be significant that there is a non-arbitrary justification of our preference for natural daylight as an illuminant. From an ecological perspective, for instance, it is with naturally illuminated light-modifying material objects – food, drink, conspecifics, predators, natural landmarks – that we are primarily concerned. At the same time,

⁴³ Austin 1962: 66.

⁴⁴ Hardin 1988: 68-9.

the other kinds of object do not anyway form as wildly a heterogeneous class as the remarks of Austin and Hardin suggest. Broadly speaking, objects can be divided into just two classes, depending upon whether they modify (reflect, refract, diffuse etc) or emit the light that reaches our eyes. The group of light-modifying objects contains medium sized dry goods, including the bioluminescent fish on the deck of the ship, the moon, the sky and clouds, along with transparent volumes. The group of light-emitting objects includes the stars, the sun, neon tubes and the bioluminescent fish in the sea at a depth of one thousand feet.

Generally speaking, light modifying objects need light to modify to exhibit their modificative behaviour. Moreover, for this behaviour to be revealed as it really is, the light that they modify should be equal energy white light (or else, as close to this as possible). The first group therefore pose no problems. Of course, we want to say that objects of the second kind can also be coloured. But this too is unproblematic. In particular, it does not require us to introduce as many different 'standard conditions' as there are objects that emit light. An object's propensity to emit light is revealed as it really is when the light that reaches the eye is the same as the light that the object emits. A light emitting object's real colour is therefore that which it appears to have when the light that reaches the eye has not in anyway been distorted: when there is nothing in between the light source and the eye to modify the light, and no other competing light sources whose illumination can overpower, or otherwise interfere with, the light emitted by the object.

So, it makes sense to say that the sun is not really red when it is close to the horizon, for instance, because the light that it emits is modified by the intervening particles in the atmosphere; for the same reason, it is not really quite as yellow as it generally appears, either, as this is also the result of atmospheric scattering. The same holds for other light emitters. Night time is the best time at which to determine a star's colour, for example, because during the day the light from a star is too weak to compete with the much more intense light from the sun. Similarly for neon tubes, and all other light emitters, including the bioluminescent fish.

The bioluminescent fish brings out the further point that the categories of light modifier and light emitter are not mutually exclusive: something can both modify light and emit it. But this is hardly any great cause for concern, either. The fact that objects can both emit and modify light does not show that the project of

trying to specify standard conditions of perception for objects that do not modify light is fruitless. It just shows that there is more than one in which objects can be coloured. *Qua* light modifier, the fish is really a muddy sort of greyish white. *Qua* light emitter, it is really vividly multicoloured.

The *third* and final qualification concerning the defence of natural daylight is that even midday daylight on a clear day does not perfectly reveal an object's colours. The spectral power distribution of natural daylight is neither perfectly smooth nor entirely flat. We therefore have to allow that there could be still *better* lighting conditions under which to determine an object's real colour than natural daylight. This is not, however, a *reductio* of the naïve view that colours are mind-independent properties. For instance, the situation is fundamentally disanalogous to the situation Berkeley argues we are in with respect to viewing distance. If nothing else, the non-arbitrary principle for deciding between different colour appearances does not render the majority of our ordinary colour ascriptions systematically false. The differences in colour appearance under natural daylight and actual equal energy white light will so negligible as to be practically irrelevant. Therefore, even if there was a slightly better illumination than natural daylight under which to determine an object's real colour, this would not effect the truth of our ordinary coarse-grained colour judgments. But the fact that there could be a still better illumination than natural daylight under which to determine the real colours of objects is anyway to be expected. Accepting that some of our more precise colour judgements may be false is the price of accepting the common sense view that colours are mind-independent; it is the price we have to pay to avoid convicting common sense thought about colour of a much more pervasive error.

[4] Inter-Species Variation in Colour Perception

He that will not set himself proudly at the top of all things; but will consider the Immensity of this Fabrick, and the great variety, that is to be found in this little and inconsiderable part of it, which he has to do with, may be apt to think, that in other Mansions of it, there may be other, and different intelligent Beings, of whose Faculties, he has as little Knowledge or Apprehension, as a Worm shut up in one drawer of a Cabinet, hath of the Senses or Understanding of a Man.

Locke 1690: II.ii.3

A non-negotiable commitment of the naïve view that colours are mind-independent properties is that there is a sharp distinction between the colours objects really are and the colours they merely appear because of facts the situation in which they are perceived. The Argument from Perceptual Variation represents an attempt to undermine this distinction, and runs as follows:

Argument from Perceptual Variation

1. x appears to be F and x appears to be G
2. x cannot be both F and G
3. there is no non-arbitrary reason to regard either appearance as illusory
4. therefore, x is really neither F nor G .²

So far I have argued that variations in the environmental conditions necessary for colour perception do not suffice to establish the argument's eliminativist conclusion. Colour perception also varies dramatically, however, across both species and members of the same species. This profound variation across perceiving subjects should cause anyone who thinks that colours are genuinely mind-independent properties deep consternation. If colour perception varies so widely, who perceives colours as they really are?

I start in this chapter by considering between species variation. This kind of variation in colour perception is the most pronounced and will turn out to require different treatment to variations in perceived colour between members of the same species. Aside from contrasting inter-species variation with an extreme form of intra-species variation – colour blindness – in §4.3, consideration of differences in colour perception between human subjects is therefore postponed until Chapter 5. Details of differences in colour perception across the animal kingdom are spelt out in §4.1. In §4.2, I argue that these variations do not threaten the common sense commitment to an appearance-reality distinction because the colours that members

of different species perceive are determinates of different, mutually compatible, determinables. The contrast with extreme forms of intra-species variation in §4.3 clarifies this response, underlining the difference between faultless inter-species disagreements and cases of intra-species variation in which error occurs. This response is further clarified by contrasting it with relationist and New Realist responses to the inter-species variation in §4.4, where I suggest that we can avoid the revisionism of relationism and the excesses of New Realism by thinking of different perceivers as *selecting* different sets of mind-independent colour properties. Finally in §4.5, I consider the sense in which the properties that different species select can properly be said to be *colours* at all.

1. Inter-Species Variation

Colour vision extends across the animal kingdom, differing dramatically from species to species. On the one hand, different species differ in the extent of their sensitivity to the electromagnetic spectrum. Humans are sensitive to light of between roughly 400 and 700 nanometres. The “visible window” for bees is shifted into the near ultra violet, ranging from 300 to 650nms. Still other creatures, like salmon, can perceive light in the infra-red region of the spectrum. And the visible window of some creatures, including diurnal birds like the pigeon, extends into both the ultra-violet *and* infra-red regions of the spectrum, spanning 350 to 720nms.

Cross-cutting differences in their sensitivity to regions of the electromagnetic spectrum, different species differ more fundamentally in the *dimensionality* of their colour vision. The human eye contains three types of retinal receptor, each sensitive to different, but overlapping, broadband spectral frequencies. As a result, humans are able to colour match any given spectral stimulus with just three appropriately chosen (visible-to-humans) spectral lights: usually lights of 460, 530 and 650 nms. In this sense, the human visual system is *trichromatic*. Human colour vision is not unique in being trichromatic – bees, macaque monkeys, and many other creatures also enjoy trichromatic colour vision. Trichromacy is, however, by no means standard. Cats, squirrels and rabbits, for instance are *dichromatic*: they have eyes that contain just two kinds of receptor, and so require just two appropriately chose spectral lights to match any given spectral stimulus. *Monochromatic* creatures lack chromatic colour

vision entirely, being able to colour match any given spectral stimulus with any other. In contrast, pigeons, goldfish, and ducks have at least four types of retinal receptor. Consequently, their colour vision is at least *tetrachromatic*, in the sense that it takes at least four appropriately chosen spectral lights to match any given spectral stimulus.¹

In humans, the signals from the retinal receptors are processed in three neurophysiologically realised, opponently organised, psychophysical channels. The resulting colour experiences can be represented in a three-dimensional space, such that any colour sample a human perceives can be completely described in terms of the three values: *hue*, or how red, yellow, green or blue a sample is, *saturation*, how ‘strong’ a colour is, and *lightness*, how black or white a colour is (§2.5). Although neither the physiology or psychophysics of colour vision in other species is known in as much detail, there is evidence to suggest that the signals from, for example, the pigeon’s retinal receptors are opponently processed in at least *four* neurophysiologically realised psychophysical channels, eventually giving rise to more kinds of colour experience than humans enjoy.

In the human case, for instance, the result of post-retinal opponent-processing is that human colours can be divided into two mutually exclusive classes. Corresponding to the three opponently organised psychophysical channels in which signals from the human retina are processed, human colour space contains six *elemental* colours: red, green, blue, yellow, black and white. The elemental colours enjoy a special psychological status. These colours admit of instances that are ‘unique’, in the sense that they appear to contain no trace of any other colour. And taken together, the elemental colours are minimally sufficient for the description of any other colour sample: so, for instance, we can describe orange in terms of red and yellow, chartreuse in terms of yellow and green, pink in terms of red and white, grey in terms of black and white, and so on. *Non-elemental colours* – the binary hues orange, chartreuse, cyan and purple, the achromatic colour grey, and darkened or lightened hues like brown, olive, pink – do not enjoy the same landmark status. Non-elemental colours do not admit of instances that are unique; they are always perceived as a mixture of other colours. Moreover, the non-elemental colours are

¹ For more details, see Jacobs 1981 and Thompson 1995: 141-60. Although for present purposes I assume that these details are correct, I sound a note of caution later (§4.4).

not generally sufficient for the description of all other colours: for instance, it is not so natural to describe red as a mixture of orange and purple as it is describe orange as a mixture of red and yellow.²

Corresponding to the extra psychophysical channel in which the signals from their extra kind of retinal receptor are processed, it is reasonable to suppose that pigeon colour space contains two more elemental colours than human colour space, bringing the total number of elemental colours that pigeons perceive to eight. This would bring with it a corresponding increase in the number of non-elemental colours that pigeons can perceive, and might even lead pigeons to perceive a completely different kind of colour, “ternary hues”, which are like our binary hues, but instead of being perceptual mixtures of two elemental chromatic colours, are perceptual mixtures of *three* elemental chromatic colours. Although I will suggest below that we need to be cautious about drawing direct comparisons between human colour vision and that of members of other species, at least for illustrative purposes, experiencing a ternary hue would be like experiencing something that is a perceptual mixture of red, green *and* blue.³

There is clearly something deeply unsettling about the thought that different species perceive colour so differently. If a human and a pigeon disagree about the colour of an object, the disagreement between them at least appears to be a disagreement about the colour of the very same object. To suppose otherwise would entail a deeply unattractive mind-dependence of objects, let alone colours. We therefore cannot deny premiss (1) of the Argument from Perceptual Variation. Moreover, neither is there obviously any non-arbitrary reason to prefer human colour vision to pigeon colour vision as revelatory of the real colours of objects. It therefore doesn't look as though we can deny premiss (3) of the Argument from

² The classification of green and brown within this framework raises questions. Probably as a result of familiarity with colour-mixing techniques, some Euro-American subjects refuse to class green as an elemental colour, maintaining that it can be further described in terms of yellow and blue. Goethe is a famous proponent of this view, claiming that “If yellow and blue, which we consider as the most fundamental and simple colours, are united as they first appear, in the first state of their action, the colour which we call green is the result”, 1810: §801; compare Berkeley 1707-8: §502 (discussed in §3.3). Conversely, subjects in some tests appear to class brown as an elemental colour. Given free use of colour terms, subjects tend to be unwilling to describe brown samples using any other terms than ‘brown’. The significance of these results is controversial, however, as subsequent tests by Quinn *et al* 1988 have shown that when told to describe a range of colour samples presented to them using only the terms black, white, red, yellow, green and blue, subjects consistently describe brown samples in terms of yellow and black. For more details, see §6.1.

³ Hardin 1988: 146, Thompson 1995: 158.

Perceptual Variation, either. To privilege human colour vision would be chauvinistic and *ad hoc*, as it is a contingent fact that our visual system functions in the way that it does and not as the pigeon's does. Indeed, if anything, it seems as though we should actually prefer the more colourful pigeon vision to human colour vision as revelatory of the true nature of colours, at least insofar as pigeons appear to perceive more colours than humans. To privilege pigeon colour vision, however, would be to give up in part what is attractive about the view that colours are mind-independent properties. Part of the motivation for defending the mind-independence of colour against the Argument from Perceptual Variation is to resist the perennially popular claim that our colour experience is inherently unreliable. Privileging the colour experience of pigeons is at least consistent with the general claim that colour perception is not necessarily misrepresentative. But this is hardly to the point. What we wanted was to justify the deliverances of *our* sensory experience.

Does it therefore follow that the colours members of different species perceive are in fact all equally apparent? Not yet. The Argument from Perceptual Variation requires that the properties ascribed to an object by different subjects are incompatible: it has to be the case that, contrary to appearances, the object cannot both be *F* and *G*. However, nothing has so far been said to suggest that the properties that pigeons and humans perceive are in fact incompatible in this way. If the colours that pigeons and humans perceive are mutually compatible, then the correct conclusion to draw from the argument from inter-species variation is not that both sets of colour appearance are equally apparent. It is that both sets of colour appearance are *equally real*.

2. Determinates and Determinables

Property ascriptions are only incompatible if the different properties ascribed are properties of the same kind. Properties of different kinds are not mutually exclusive. So, for instance, although objects cannot simultaneously be circular and square, they can be simultaneously red and square, moving and tall, beautiful and morally abhorrent.

The distinction between determinates and determinables represents a useful way of spelling this out. Associated with each determinable property are a number

of, what Funkhouser has recently called, “dimensions of determination”.⁴

Dimensions of determination are those respects in which determinates of a given determinable differ: in the case of human-colour, for instance, hue, saturation and lightness. The determination dimensions associated with a determinable property jointly define a property space in which any determinate of that determinable can be located. Incompatibility arises when the same object is assigned different sets of values along the same dimensions of determination, or, in other words, when it is ascribed properties that occupy different regions of the same property space.⁵

At least on the face of it, the property spaces in which the colours that members of different species perceive do indeed differ. Tetrachromatic pigeons perceive more colours than trichromatic humans, who, in turn, perceive more colours than dichromatic cats. The space defined by the colour properties that pigeons perceive is therefore larger than the space defined by the colours that humans or cats perceive. And by a simple application of Leibniz’s Law, it may now seem to follow that the properties that pigeons and humans perceive are just determinates of different determinables, and therefore mutually compatible.

As it stands, this is too quick. Bare difference in size of property space is not itself sufficient for sameness or difference of determinable property. All but the most general properties are determinate or determinable only relative to other properties. Properties that are themselves determinate relative to a more general determinable, however, *are* mutually incompatible. Take yellow and red, which are determinable relative to lemon yellow and scarlet respectively, but themselves determinate relative to human-colour. An object cannot simultaneously be yellow and red: determinates of the mid-level determinables yellow and red vary along the same dimensions of determination and consequently, the property spaces associated with the mid-level determinables yellow and red are both proper parts of the larger property space associated with the determinable property, human-colour. By parity of reasoning, there will therefore be a problem if it turns out that the determinable property human-colour is itself determinate relative to pigeon-colour, or perhaps, if both are determinate to a still higher-level super-determinable property, COLOUR. If human-colour is itself determinate relative to pigeon-colour, or both are determinate

⁴ Funkhouser 2005.

⁵ I consider problems with less demanding ways of spelling out sameness and difference of property-type in §5.1.

relative to COLOUR, then an object could not be both human-coloured and pigeon-coloured, either. But is this the right way to think about colour?

For human-colour to determine pigeon-colour, and both to determine a super-determinable, COLOUR, human-colour space would have to be a proper subset of pigeon-colour space, and pigeon-colour space a proper subset of the space associated with COLOUR. Given that the property space associated with a determinable is defined by its dimensions of determination, this means that human-colours, pigeon-colours and colours more generally would all have to vary along the same dimensions of determination. On reflection, however, there is reason to suppose that the dimensions of determination along which, for instance, human-colours and pigeon-colours vary are actually very different. As such, it seems that the property spaces associated with human-colour and pigeon-colour are in fact wholly disjoint; in which case human-colour and pigeon-colour are themselves super-determinable properties.

Consider, first, *hue*. It is important to resist the often overwhelming temptation to think of pigeons simply perceiving the same hues that humans perceive plus some extras, consequent upon their increased spectral sensitivity and more complicated visual processing mechanisms. Even in the region of the spectrum to which humans and pigeons are both sensitive, the colours that humans and pigeons perceive differ markedly. Experiments by Wright and Cummings, for instance, suggest that pigeons perceive spectral light falling either side of 540nms as completely different in hue. Humans, in contrast, perceive 540nms light as green-yellow. Whilst 540nms therefore marks a boundary between pigeon hues, it doesn't mark a boundary between human hues.⁶

To say 540nms marks a 'hue boundary' for pigeons already threatens to stretch the meaning of the word 'hue' to breaking point. Hue is standardly defined in terms of the human hues that lie around the human hue circle: the definition of hue standardised by the International Commission on Illumination (the C.I.E.), for instance, is that "Attribute of visual sensation that has given rise to the colour names, such as: blue, green, yellow, red, purple etc".⁷ By this definition, a dimension

⁶ Wright and Cummings 1971. For discussion, see Jacobs 1981: 117-8, and Thompson 1995: 150-1.

⁷ See Hardin 1988: 212.

of determination along which there are colours that have no location on the human hue circle is not a dimension of *hue* at all.

Of itself, this definitional point does not go very deep. The C.I.E. definition of hue is best seen as an attempt to regiment colour vocabulary for use in narrowly circumscribed situations, and cannot just be taken as an authoritative guide to its use outside of those contexts. Indeed, the C.I.E. definition betrays the scientist's latent eliminativism, defining 'hue' as 'an attribute of visual sensation': but of course, this is not what the vulgar mean by this term, who use 'hue' to refer to an attribute of *material objects*. Still, there is an important underlying point that the C.I.E. usage, perhaps unwittingly, picks up on. This is that the circular structure of the dimension hue precludes the possibility of any extra hues being added along this dimension: there is no point on the human hue circle at which any extra hues could be simply slotted in. The hue circle is a closed space in which every region is occupied. The only way to accommodate the extra colours along the dimension of hue would be by widening the hue circle. But distances on the hue circle represent in extrinsic, spatial terms, internal relations of similarity between the colours: relations in which a property must stand to be that very property. By changing the distances between properties on the hue circle, you change the internal relations that the hue circle represents, and you thereby change the properties that lie on that circle. The extra colours that pigeons perceive therefore cannot be located on *our* hue dimension. If pigeon-colour space is a three-dimensional space, then its third dimension is not *hue*.

It is important to note in this respect that hue cannot just be identified with "dominant wavelength", either: the colorimetric property which specifies the wavelength of the monochromatic light that would colour-match the object (or stimulus) when suitably mixed with a specified achromatic light. Dominant wavelength is a psychophysical property that is independent of the nature of the subject performing the colour match. Although we can therefore directly compare the dominant wavelengths of objects for members of different species, dominant wavelengths are not hues. Dominant wavelengths, for instance, do nothing to explain the circular structure of the hues. If dominant wavelengths were hues, then we should expect samples with dominant wavelengths of 400nms and 700nms, lying at either end of the human visible window, to look maximally different. However,

dark blue and dark red, the human hues with which these wavelengths are associated, actually lie next to each other on the hue circle.

Ignoring the problems to which the experiments by Wright and Cummings point, it might at least seem possible that the extra colours pigeons are supposed to perceive should lie along a *fourth* dimension of determination, such that the pigeon's colour space is a four-dimensional space in which three of the four dimensions are identical to those of human-colour space.⁸ It is certainly true that not all determinable properties come with a fixed number of determination dimensions. Consider shape. Triangles, squares and pentagons are all shapes. Because these figures all have different numbers of sides, each figure requires a different number of determination dimensions depending on how many sides it has. Again following Funkhouser, we can therefore say that at least some super-determinables come, not with a limited number of determination dimensions, but with "a schema for producing such determination dimensions": in the case of shape, for instance, that for each side an object has there is another determination dimension that represents that side's length.⁹ If this is the right model on which to understand the relationship between human-colour and pigeon-colour, then clearly the problem of incompatibility resurfaces: just as nothing can be simultaneously triangular and square, so nothing could be simultaneously human-coloured and pigeon-coloured.

Colour, however, is crucially unlike shape in this respect. In particular, there is no analogue of the determination dimension schema for shape in the case of colour. In the geometrical case, the schema for producing dimensions of determination allows us to move between mid-level determinables simply by adding in more dimensions *of the same kind*. When, for instance, we move from triangles to quadrilaterals, we simply add in an extra determination dimension for the extra side that quadrilaterals have. This determination dimension does not differ in kind to the dimensions that we are already working with, and in respect of which triangles vary: it is just an extra dimension of side length to correspond to the quadrilateral's extra side.

⁸ This is how Thompson tries to make sense of the existence of novel colours: "whereas we are trichromats and have a colour space of three dimensions, Fred [who sees novel colours] is a *tetrachromat* and has a four dimensional colour-hyperspace", 1992: 336.

⁹ Funkhouser 2005.

We cannot move between multi-dimensional colour spaces in the same way, however. Just consider the three-dimensional human-colour space (Figure 2.4). The three dimensions of human-colour space each differ fundamentally *in kind*. Were we to try to move to three-dimensional chromatic colour space from a one-dimensional achromatic colour space by adding in more dimensions of the same kind, we would add in dimensions with absolute beginning and end points, like the achromatic dimension lightness that begins with black and ends with white. We cannot extrapolate the dimension hue in this way, however. The dimension hue is not conceptually bipolar, but circular: there are no absolute beginnings or endings, but rather each part eventually shades into every other. Unlike hue, saturation is at least a bipolar dimension of variation: colour samples vary from maximal saturation at the circumference of the hue circle to unsaturated at the central achromatic axis. Nevertheless, saturation is also a very different dimension of determination from both lightness and hue, something reflected in the fact that the dimensions of hue and lightness are conceptually much easier to grasp than saturation. Differences in lightness and hue are typically thought of as variations in ‘colour’, whereas differences in saturation are more usually thought of just as differences in one and the same colour. Indeed, saturation is *defined* as variation in the ‘strength’ of a colour.¹⁰

The extra colours that pigeons perceive therefore cannot be located on our hue circle, nor is there any obvious determination dimension schema that would allow us to generate extra dimensions on which to locate these properties, either. The determination dimension hue is, as such, unique to human colour space: whatever analogous dimension of determination pigeon colours may vary along, it is not *hue*. Clearly, given that saturation is defined in terms of hue, saturation is unique to human colour space if and only if hue is. But what about the third dimension of human colour space: lightness? Can’t we at least imagine a colour space that differs to ours in respect of hue and saturation, but still contains the achromatic colours: black, white and grey?

Even if we grant that there could be a colour space that differs from ours in all its dimensions of determination except lightness, this would fall short of

¹⁰ More precisely, it is defined by the C.I.E as “Attribute of a visual sensation which permits a judgement to be made of the proportion of pure chromatic colour [i.e. hue] in the total sensation”, Hardin 1988: 214.

establishing outright the incompatibility of human-colours with colours of this other kind. It would not follow that human-colour space is a proper part of, for instance, pigeon-colour space, or that both occupy regions of a still larger space associated with a super-determinable property, COLOUR. At best, it would show only that these spaces share a common dimension of determination. And this is not so obviously problematic. Besides, it is not clear we should even concede this much. Just because the achromatic colours enjoy a greater *conceptual* independence from the chromatic colours, it doesn't follow that they are therefore *metaphysically* independent. To suppose that there could be a colour space that differs from ours in respect of hue and saturation, but still contains the achromatic colours, begs the question against the view that the relations in which colours stand are logically necessary internal relations; that colours could not *but* stand in precisely the relations in which they actually stand. Perhaps all the act of conception amounts to is conceiving of certain human-colours that necessarily bear internal relations to red, green, blue and so on, without at the same time conceiving of these further human-colours. But this offers no support to the claim that black, white and grey could be internally related to *other* colours.¹¹

There is reason to suppose, then, that the dimensions of determination along which human-colours and pigeon-colours are *just different*. Given that determinable properties are defined by their dimensions of determination, this means that human-colour and pigeon-colour are themselves super-determinable properties: as W.E. Johnston, who coined the determinate-determinable terminology would say, they are distinguished by the complete “otherness” of their determinates.¹² And if this right, then the colours that different species perceive are not, as the Argument from Perceptual Variation requires, incompatible. They are just determinates of different, mutually compatible, determinables.

¹¹ Compare Hilbert and Kalderon 2000: 206ff. In saying that the relations between colours are internal relations, it does not follow that we can know what relations a colour stands in simply from prior acquaintance with that property. It is supposed to be metaphysically necessary that colours stand in certain similarity relations, not analytic.

¹² 1921 i: 175-6. It should be noted that Johnston himself simply assumes that human-colour is a super-determinable property, and does not consider whether there might be other colours that differ along different dimensions of determination.

3. Colour Blindness

In advance of a more detailed discussion of inter-personal differences in colour perception in Chapter 5, it will help to clarify this response to the Argument from Perceptual Variation to compare inter-species variation with a pronounced case of intra-species variation: human colour blindness.

Ignoring more unusual cases of cortical colour blindness, colour blindness occurs because of defects in at least one of the three cone types found in the retinas of normal human observers. Red-green colour-blind *deuteranopes*, who comprise roughly 1.4% of the human population, for instance, lack pigments in their **M** cones (cones sensitive to medium-wavelength light of roughly 430-640nms). Red-green colour-blind *protanopes*, who comprise roughly 1.2% of the human population, in contrast, lack **L** cone pigments (cones sensitive to long-wavelength light of roughly 450-675nms). The very rare yellow-blue colour-blind *tritanopes*, who only comprise about 0.0015% of the human population, lack **S** cone pigments (cones that are sensitive to short-wavelength light of roughly 400-520nms). Finally, *monochromats*, who comprise only about 0.005% of the human population, have either just one kind of functioning retinal cone – typically an **S** cone – or, more usually, lack any cone function at all, and rely solely upon the use of the retinal rods that are used in normal trichromatic subjects for night-time vision.¹³

Objects that on a given occasion are visually indiscriminable for a colour blind subject are not thereby absolutely indiscriminable. The phenomenon of metamerism means that objects that appear identical in colour under one illumination can appear different in colour under another, if the different illuminants accentuate differences in the objects's surface reflectance properties. This, in turn, can allow people who are colour blind to make many of the same colour distinctions as their trichromatic counterparts. Under illuminants whose spectral power distribution is weighted towards the higher wavelength red part of the visible spectrum (illuminants with a 'low colour temperature'), for instance, colour blind subjects can often distinguish red and greens, and purples and blues, that are indiscriminable in full natural daylight, given that red objects typically reflect a greater proportion of long wavelength light than green objects, and purple objects

¹³ For details see Jacobs 1981, Hurvich 1981 and Boynton and Kaiser 1996.

reflect a greater proportion of long wavelength than blue objects. Illuminating objects with light whose spectral power distribution is skewed in favour of the lower wavelength blue part of the spectrum (illuminants with a ‘high colour temperature’) has the same effect, but for the opposite reasons.¹⁴

Still, people who are colour blind cannot make all the same colour distinctions as their normal trichromatic counterparts. Even so, it does not follow that people who are colour blind thereby perceive colour properties that differ in kind to the properties perceived by normal trichromatic humans. Properties differ in kind if they are located in differently structured property spaces. Although colour blind subjects cannot make the same colour distinctions as their normal trichromatic counterparts, and so the properties they perceive define a smaller property space than full human-colour space, this doesn’t mean that they thereby differ in kind. Bare difference in size of colour space is not sufficient for difference of colour property. What sets these more extreme cases of intra-species variation apart from inter-species variations is that colour blind subjects perceive properties that vary along the same dimensions of determination as the colours perceived by normal trichromatic subjects.

The term ‘colour blind’ is potentially misleading in this respect. It can seem to imply that people who are (to use what is perhaps a better term) colour deficient lack *any* perceptual access to the colours perceived by normal human subjects, just as subjects who are blind lack any perceptual access to the visual world. But we know – from people who acquire colour deficiencies later in life, cases of unilateral dichromacy in which subjects are born with one normal and one abnormal eye, reports from standard dichromatic subjects and educated guesswork – that this is just not the case. The colours that colour blind subjects perceive are a subset of those perceived by normal trichromatic subjects.¹⁵

The majority of colour blind humans – red-green colour blind deuteranopes – for instance, in fact appear to experience only a greater or lesser degree of ‘collapse’ of the red-green dimension of normal trichromatic colour space. At least

¹⁴ Hurvich 1981: 250. At the 2005 European Society for Philosophy and Psychology Conference, Justin Broackes suggested that people who are colour-blind can therefore exploit differences in the spectral composition of (blue) skylight and (yellow) direct sunlight to perceive the colours of objects.

¹⁵ For discussion, see Kaiser and Boynton 1996: 452-5. Malebranche mentions something that sounds like it might be a case of unilateral dichromacy, suggesting that there are “people who see certain objects yellow with one eye and as green or blue with the other”, 1674-5: 66. Whether Malebranche was really aware of this condition, or whether he was just saying this for rhetorical force, however, is not clear.

under favourable perceptual conditions, they do not even lack entirely the ability to distinguish between red and green: they lack merely the ability to make the full range of fine-grained red-green distinctions available to normal human subjects.¹⁶ Even human subjects whose colour vision is genuinely less than trichromatic, in the sense that they require less than three appropriately chosen spectral lights to colour match any given spectral stimulus, however, still see a subset of the colours perceived by normal human observers. Red-green colour blind protanopes, for instance, can at least see the same yellows and blues as normal trichromatic subjects. The much less common blue-yellow colour blind tritanopes can at least see the same reds and greens as normal trichromatic perceivers. And even wholly monochromatic subjects at least perceive the same achromatic colours as normal subjects.

This last point is worth stressing, as the achromatic colours typically receive a very bad press. Since the seventeenth century – and Newton’s work on light in particular – it has come to seem little more than scientifically ‘enlightened’ common sense to suppose that the achromatic colours black and white are not really colours at all. According to this way of thinking, black is said to be ‘the absence of all colour’ and white ‘the simultaneous presence of all colour’. The extent of the prejudice against the achromatic colours is revealed by even the briefest survey of the literature on Mary, Jackson’s omniscient scientist raised in an entirely achromatic environment. Lewis’s description of Mary’s predicament is wholly representative:

Mary, a brilliant scientist, has lived from birth in a cell where everything is black or white...But she doesn’t know what it’s like to see colour.¹⁷

Clearly, the only way that Mary could have been raised in a cell where everything is black and white and not know what its like to see colour is if black and white are not themselves colours.¹⁸ Whatever else might be wrong with this view of colour – and we shall see in §6.2 that there is a lot else wrong with this view of colour – it is at least false to the phenomenology of achromatic colour perception.

¹⁶ Shepard 1992: 333, 338.

¹⁷ Lewis 1988: 500.

¹⁸ Incidentally, it would be better here to say, not ‘know what its like to see colour’, but ‘know what the colours seen are like’. Generally speaking, it is odd that the knowledge argument should be thought to be an argument for the existence of intrinsic non-physical properties of *conscious subjects*, when what Mary has never before perceived are (seemingly non-physical) properties of *material objects* (i.e. colours). See also the discussion of spectral inversion in §6.5.

When we say that monochromats do not perceive the colours that normal trichromatic subjects perceive, we are not saying that monochromats perceive objects as *colourless*. We are saying merely that they perceive some, but not all, of the colours that normal human subjects perceive.

The achromatic colours (the clue here is in the question: the achromatic *colours*) are perceived to bear the same relationship to the surfaces of material objects as the hues yellow, red, green and blue. Like these hues, they come in degrees (or shades). They can be mixed with the hues to create new colours: pink is whitened red, olive blackened green, brown blackened yellow. Indeed, we can even formulate a version of the knowledge argument for the achromatic colours. Consider Mary's sister, Katy. Like Mary, Katy knows everything there is know about the physics of colour and colour perception. Like Mary, Katy has had a sheltered upbringing. Where Mary and Katy differ is just that, whereas Mary has only ever seen black and white, Katy has only ever seen the maximally saturated colours that lie around the circumference of the hue circle. If Mary learns something new when she leaves her purely achromatic environment, then surely Katy also learns something new when she leaves her purely chromatic environment.¹⁹

The important point to stress here is that the property spaces defined by the properties perceived by colour blind subjects and normal subjects are not disjoint in the way the spaces defined by the properties perceived by members of different species are. Intra-personal differences in colour perception, like those that arise in cases of colour blindness, cannot just be faultless disagreements. The colours that members of different species perceive are mutually compatible because they are just determinates of different determinables. The properties that members of the same species perceive, in contrast, vary along the very same dimensions of determination, and therefore occupy regions of the same property space. As such, they are determinates of the very same determinables. Consequently, the response to the Argument from Perceptual Variation made in relation to inter-species differences does not carry over to the intra-species case. We cannot just deny premiss (2).

¹⁹ Compare Locke's response to Descartes's claim that blackness is a mere 'privation' in objects: "A Painter or Dyer, who never enquired into their causes, hath the *Ideas* of White and Black, and other Colours, as clearly, perfectly, and distinctly in his Understanding, and perhaps more distinctly, than the Philosopher, who hath busied himself in considering their Natures, and thinks he knows far either of them is in its cause positive or privative", 1690: II.viii.3.

The crucial difference between inter- and intra-species variations is that in cases of intra-species variation, the idea of *error* gets a grip. The question of how we should apportion error in more common or garden cases of intra-species variation is discussed in Chapter 5, but at least with respect to the extreme intra-species variation in colour perception that we get between normal and colour blind subjects, there is a clear a non-arbitrary reason to suppose that normal trichromatic perceivers have a better insight into the real colours of objects than their colour deficient counterparts: we can therefore deny premiss (3) of the Argument from Perceptual Variation instead. Although it is not an especially far reaching disability, colour blindness is not called colour *blindness* for nothing. There is nothing chauvinistic or *ad hoc* about this, either, as it is not just that people who are colour blind are deficient with respect to the normal colour perceiving population. People who are colour blind are deficient even by the standards of their own psychology.

In cases of colour blindness which are the result of retinal abnormalities, the higher level processing mechanisms associated with colour experience generally remain intact. As a result, the innate capacity for experiencing the full range of human-colours remains, even if this capacity is never actually realised. Experiments by Shepard and Cooper on the representation of colours in the blind, colour blind and normally sighted, for instance, show that colour blind subjects at least grasp the basic structure of normal human colour space, even if the colours that they actually perceive define a degenerate version of this space. Shepard and Cooper asked subjects to judge the similarities amongst different hues, first when pairs of those hues were actually presented, and second when those hues were merely named. Whilst in the first case the judgements of colour blind subjects (red-green colour blind deuteranopes and protanopes in particular) yielded a degenerate version of the hue circle, in which two of the sides were collapsed together, the results of the colour naming task were by and large the same across the colour blind and normal trichromats alike.

Although, as Shepard and Cooper themselves point out, it possible that the grasp of the structure of colour space that the colour blind display represents nothing more than a prolonged exposure to the linguistic practices of normally sighted trichromatic subjects, there is reason to resist so superficial an explanation. Even though colour blind subjects are unable to naturally perceive the range of

colours that normal subjects perceive, they at least appear to still have the latent capacity to enjoy experiences of this kind. Otherwise unperceivable colour experiences can, for instance, be induced in colour blind subjects using Benham disks: half-black, half-white disks that when rotated (at about 6-8Hz) generate “subjective colours” which appear as desaturated bands of different hues, depending on the exact speed of the disk. Indeed, Shepard and Cooper even report that one particularly articulate protanope, although unable to distinguish between red and green objects that are presented to him, claimed to at least be able to *imagine* the vivid reds and greens that normal trichromatic subjects perceive.²⁰

The reason why people who are colour blind do not form a different species of colour perceiver is that their colour vision is frustrated by defects in their physiology. Their colour vision is deficient with respect to the colours that they are designed more generally to perceive; or, to use a metaphor that I will explain in more detail in the next section, their visual system as a whole *selects* properties that deficiencies in their perceptual apparatus render them unable to perceive. By the standards of their own psychology, we should therefore prefer the colour experience of normal trichromatic subjects to that of subjects who are colour blind.²¹

4. Selectionism

In response to inter-species differences in colour perception, I have been arguing that we should reject premiss (2) of the Argument from Perceptual Variation, which states that the properties ascribed to an object by members of different species are incompatible. It will help to get a still clearer grasp of what this amounts to by

²⁰ For details, see Shepard 1992: 338-9. It is therefore not necessarily true to say, as Hardin does, that “a true red-green dichromat...can form no notion of [red and green] beyond an appreciation of their functional role in the lives of others”, 1988: 145.

²¹ It has been suggested that some female humans may, like pigeons, be tetrachromatic. On the basis of differences in spectral sensitivity (see §5.2), the long-wavelength cone in males is sometimes thought to be polymorphous; it is sometimes thought that there are, in effect, two different kinds of long-wavelength cone amongst the male population. If this is right, then it seems possible that there might be heterozygous women who possess four cone-types in total: both long-wavelength cone types, in addition to short- and middle-wavelength cones (Mollon 1992). If this were the case, then these ‘superwomen’ might stand in the same relation to normal trichromatic subjects that normal trichromatic subjects stand in to true dichromats: there would be colours that are forever hidden from the male sight. It should be stressed, however, that is all highly speculative. As things stand, there is no hard empirical evidence for the existence of human tetrachromacy. Indeed, it is debatable even whether there are two types of long-wavelength cone in the male population at all (see, for instance, Jordan and Mollon 1995). The jury is still out on this one.

comparing this response to two other responses to the Argument from Perceptual Variation that deny the same premiss.

Premiss (2) of the Argument from Perceptual Variation, for instance, is the premiss that relationists about colour reject in response to *all* forms of variation. Does this mean that, at least with respect to inter-species variation, this view collapses into relationism? In his 'Relationist Manifesto', for instance, Jonathon Cohen argues cases of inter-species variation show that we should adopt "the ecumenical policy that both sorts of visual systems are right, and that one and the same object can have more than one color property". According to Cohen, however, this is tantamount to treating colours as relational properties, properties that are "constituted in terms of relations between objects and subjects".²² Cohen's relationalism isn't as strong as the relationism that Berkeley uses the Argument from Perceptual Variation to try to establish: whereas Berkeley thinks that a colour experience logically implies the existence of the property that it is an experience of, Cohen at least tries to allow for the possibility of colour illusion (whether he is actually able to accommodate it is another question; see §5.1). Still, if Cohen is right that to adopt an ecumenical policy towards colour is to be a relationist about colour, then we haven't evaded the force of the Argument from Perceptual Variation after all.

Fortunately, saying that different species perceive determinates of different determinable colour properties is not inconsistent with the claim that these properties are genuinely mind-independent. To call a property mind-independent is to say at least that we can make sense of its unperceived existence: that we can make sense of its persistence through gaps in our observation of it because, for example, the conditions necessary for its perception do not hold. What this requires is that we have a way of thinking of the property that is at least one step removed from our sensory experience of it: as Evans puts it, that we are able to recognise the "implicit duality" of our experiences of it (§2.1). Saying merely that different species perceive determinates of different determinable colour properties is not to say that these properties could not exist unperceived. Quite the opposite. It is grasping the fact that these properties *are* determinates of different determinables that puts us in a position to grasp their mind-independent existence in the first place.

²² Cohen 2005.

As we have already seen, our grasp of mind-independent existence depends in part upon our grasp of the internal relations of similarity and difference in which determinates of a determinable stand, and which marks them out as determinates of that very determinable. We can think about shapes at one step removed from our sensory experience of shape, for instance, by thinking abstractly about the internal relations of similarity and difference that hold between determinates of the determinable shape. For example, we can think about shapes in terms of the equations of analytic geometry, representing similarities and differences between shapes in the similarities and differences in the equations that we use to describe these shapes: the greater similarity between circles and ellipses than between circles and squares, for example, can be represented by the greater similarity between the equations used to describe circles, ellipses and squares. Similarly for colours. At least in part what grounds our conception of colours as mind-independent properties that are *there to be experienced* is our grasp of the similarities and differences between determinates of the determinable, colour. We can think in fairly abstract terms about determinate colours in terms of the relations of similarity and difference in which different determinate colours stand: that, for instance, yellow is more like orange than red. As with shape, this gives us the way of thinking of colours at one step removed from our sensory experience of colour necessary for grasping the continued existence of colours in the absence of the enabling conditions of colour experiences. In other words, it is by grasping the relations constitutive of what it is for properties to be determinates of the same determinable that at once allows us to recognise that different species perceive determinates of mutually compatible determinables, and that these properties are robustly mind-independent.

This is something that a traditional way of pointing to a disanalogy between colour and shape tends to obscure. For instance, following a suggestion by Johnston, Wright suggests that the crucial difference between shape and colour is reflected in how we read biconditionals of the form:

x is F iff x would look F to standard observers in normal conditions.

When the value of 'F' is 'square', Wright suggests that we should accord priority to the left hand side of this biconditional, so that it follows from something's being

square that it is such as to look square in normal conditions. Wright calls this a *detectivist* reading of the biconditional: looking square in normal conditions represents a way of *detecting* whether or not squareness is present. When the value of 'F' is 'yellow', however, Wright suggests that the priority should be accorded instead to the right hand side of the biconditional, so that it follows from something's such as to look yellow in normal conditions that it is yellow. This is called a *projectivist* reading of the biconditional: looking yellow in normal conditions is just what it is to be yellow.²³

What difference there is between colour and shape, however, is not adequately captured by the detectivist-projectivist distinction. Crucially, these options are not exhaustive: there is a third way between detection and projection, *selection*. According to the selection view, colours are not projected because they exist in the absence of the relevant kinds of response. But neither are they just detected, because they are not properties that just anyone can perceive. Instead they are selected, in the sense that which kind of colour property a subject perceives is determined by facts about the nature of that subject.²⁴

The key to the selection metaphor is not to think of colours as somehow 'springing into existence' in the presence of appropriate perceiving subjects. If a necessary condition of the existence of colours is the existence of subjects to perceive them, this would make colours strongly mind-dependent. But this is not how the selectionist thinks of colours. On the selection view, colours exist independent of human subjects: even if there never had been, nor ever would be any human perceivers, colours would still exist; they would just never have been perceived. To borrow an Aristotelian analogy used by Pritchard, the relation of colour to perceiver is less like that of patient to doctor, and more like that of sick person to doctor. Whilst the existence of a patient implies the existence of doctor whose patient he is, the existence of a sick man implies only the *possible* existence of someone to doctor him. Likewise, the existence of colours does not imply the actual

²³ 1992: 108-39.

²⁴ The selection metaphor is explicitly employed by Hilbert and Kalderon 2000. In his discussion of Hilbert and Kalderon, Shoemaker 2003 is at least sympathetic to the idea. Wiggins 1987 can perhaps be read as proposing a kind of selectionism, and, despite his insistence that colours are relational properties, Thompson's 1995 "enactive" theory of colour at least has a certain theoretical affinity.

existence of an appropriate colour perceiver, but only the *possibility* of an appropriate colour perceiver.²⁵

Avoiding the spectre of relationism, however, raises a different worry. Relationists about colour are not the only section of the philosophical community to reject premiss (2) of the Argument from Perceptual Variation, the claim that the different colours objects appear to have are incompatible. In response to the so-called ‘brick-bat’ conception of reality, for instance, the New Realists of the early twentieth century suggested that objects might really have as many colours as there are colours that they appear to be. For the New Realists, what exists is just what we experience to exist. As T. Percy Nunn, a British sympathiser of the New Realist movement, puts it: “Only empirical experience can decide what qualities it is possible, and what it is impossible, for a body to wear together”.²⁶

The highly inclusive conception of reality with which New Realism ends up is ultimately too extravagant to be taken seriously (§3.4). But the same might appear to be true of the current response to the Argument from Perceptual Variation. Doesn’t this also over-populate the material world with as many different types of colour property as there are species to select them? It would be churlish to deny that there are points of contact between the current proposal and New Realism, especially with respect to the suggestion that perceptual experience can reliably function as criterion of ontological commitment. But this should not blind us to what are nevertheless substantial differences.

The first thing to stress is that the selection view is *in general* far less excessive than its New Realist counterpart. Like relationism, New Realism offers a wholly general response to the Argument from Perceptual Variation. All kinds of variation are treated in exactly the same manner; the difference between the relationist and the New Realist is just that the New Realist does not think it necessary to denigrate in any way the properties objects really have when they appear a certain way. Because, in contrast, selectionism is only presented as a response to the inter-species version of the Argument from Perceptual Variation, however, it lacks this generality. According to the selectionist, objects do not in general have as many colour (or

²⁵ 1909: 129.

²⁶ 1909-10: 208.

appearance) properties as there are ways in which they appear. They have a more limited stock of properties that sometimes appear other than they really are.

With more *specific* reference to inter-species variation, the excesses of the selectionist proposal are not necessarily so wild. For one thing, the extent to which colour vision actually varies across the animal kingdom is something of an unknown quantity, and so could turn out to be a lot less than initially expected. Comparative ecology is not an exact science. Short of actually perceiving the world from another creature's perspective, we cannot definitively know what that experience is like: outside of fairytales, for instance, no creatures subsequently acquire the colour vision enjoyed by other species in the way that human subjects can acquire colour vision defects later in life. The best that we can do to determine how other species perceive colour is to hazard a guess based on certain kinds of third personal information. The stock of information on which we can rely, however, radically underdetermines the answers to the questions in which we are interested.

Consider the dimensionality of colour vision: the feature of vision that is determined by the number of types of retinal receptor the perceiver possesses, and is operationally defined in terms of the number of spectral lights it takes to a subject to colour match any given spectral stimulus (§4.1). I have followed the majority of visual scientists in assuming that, for instance, pigeon colour vision is at least tetrachromatic. But as Shepard points out, this assumption raises serious methodological questions. Direct anatomical investigation of other colour perceivers is hampered by significant physiological differences in all but the most closely related species. The retinal receptors of pigeons, as well as some fish, amphibians and reptiles, for instance, contain oil droplets in addition to the pigments also found in mammalian retina, the functional significance of which can only be indirectly inferred. Even assuming that we have correctly identified all the relevant receptor types, the discovery of types of retinal receptor is anyway only an imprecise guide to the dimensionality of vision. On the one hand, the signals from two or more different types of retinal receptor may subsequently be combined in just one post-retinal channel. On the other hand, there may be types of retinal receptor than have no relevant functional significance at all. Indeed, the trichromatic human retina itself contains not three, but *four* kinds of retinal receptor – three types of cone, plus rods that are traditionally thought to form part of distinct visual system for low-

illumination vision. More direct psychophysical techniques for determining the dimensionality of a pigeon's colour vision face more practical difficulties. For instance, we can hardly ask pigeons to themselves adjust a number of different lights to create a colour match for a spectral stimulus. At best we can only train them to respond appropriately when presented with colour samples that are indiscriminable. And, if nothing else, this makes accurately determining the dimensionality of another creature's vision an exceptionally laborious task.²⁷

Moreover, it is not anyway with low-level features of colour vision that we are ultimately concerned, but with the psychology of the colour *experiences* to which these low-level mechanisms give rise. It is the *phenomenology* of experience that determines whether or not two appearances conflict: whether an object simultaneously *appears* to have two properties that have a location in the same phenomenologically defined property space. For all we know, there may be countless ways of realising phenomenologically identical colour experiences. Differences in lower-level mechanisms, for instance, may simply be cancelled out by higher-level processing; certainly amongst human perceivers, there indeed appears to be a considerable amount of functional plasticity in the neurophysiological realisation of our processing mechanisms (for more details, see §5.3). Just because different species differ physiologically, it doesn't necessarily mean that their experiences differ phenomenologically. Indeed, the bare presence of low-level perceptual mechanisms probably does not guarantee the existence of perceptual *experience* at all. It seems reasonable to suppose that some of the more basic creatures that are sensitive to variations in light lack any phenomenology at all.²⁸

More generally, the selection view is not just a license to print money where colours are concerned. Different species select different sets of properties to be colours depending on the nature of their perceptual system. The human perceptual system is such that it selects properties that differ along the dimensions of hue, saturation and brightness. Maybe the pigeon's perceptual system is such that it selects a different set of colours. But the choice of perceptual system is probably not, in the first place, wholly unconstrained. The kind of perceptual system an animal has is not a purely arbitrary matter, but itself depends in part upon the nature

²⁷ Shepard 1992: 334–6.

²⁸ Hilbert 1992. John Campbell made a similar point in a paper at the 2005 European Society for Philosophy and Psychology Conference.

of the *environment* in which it evolves. As Shepard stresses, it is unlikely that the distinctive phenomenology of colour experience is simply a product of accidental features of the human visual system. It is much more plausible to suppose that it represents an adaptation to regularities in the terrestrial world. Indeed, in the case of trichromatic colour vision in primates, for instance, it is widely believed that colour vision evolved in response to, and in conjunction with, the evolution of coloured fruits such as mangoes, bananas and fruits in the citrus family.²⁹ If so, then there is a dual dependence of subjects and objects. Which properties are selected will depend upon the nature of the selecting perceptual system. The nature of the selecting system will in turn depend upon the nature of the properties in their evolutionary environment that are there to be selected. In effect, the two will, to use David Wiggins's term, be *coeval*.³⁰

5. The Unity of Colour

I have been arguing that differences in colour perception across species are faultless disagreements because the colour properties that members of different species perceive are just determinates of different, mutually compatible, determinables. But if the properties that different species perceive really are determinates of different determinables, then why say that they are *colours* at all?

Wittgenstein remarked of someone who could perceive novel colours that “it is by no means clear that we *must* say of them...that they know other *colours*”. With this in mind, it is often suggested that it is constitutive of a property's being a colour that it bear some internal resemblance relation to a property that has a location within human-colour space.³¹ According to Hardin, for instance, to speak meaningfully of alien colours – “sensory qualities that may be said to have a hue, but a hue that is not identical with red, yellow, blue, green, or any of their binaries” – the alien colour must have an “appropriate resemblance relation” to human hues; the alien hue and at least one of the standard hues must “occur within the consciousness

²⁹ Mollon 1989: 390.

³⁰ Wiggins 1987.

³¹ 1977: §42. Wittgenstein is actually himself more cautious, adding that “we could imagine circumstances under which we would say, ‘These people see other colours in addition to ours’”.

of an individual”.³² Thompson similarly requires that for a property that lies outside our colour space to be a colour, there must be “some resemblance route from our colour space to the novel colour space”.³³

In saying that human-colours and the colours perceived by members of different species are determinates of different determinables, the existence of an internal resemblance between these colours is precisely what is being denied: whereas human-colours bear internal relations of similarity to each other, and, for instance, pigeon-colours internal relations of similarity to each other, there are no internal relations of similarity between human-colours and pigeon-colours. Yet, at the same time, it is not entirely plausible to suppose that other species do not perceive *colours*. Although comparative ecology is not an exact science, it wouldn’t be possible at all if other species did not have perceptual mechanisms that are at least in some sense similar to those found in humans. And it seems incredible to suppose that other species should use these essentially similar perceptual mechanisms to perceive properties that differed fundamentally in kind to the properties that humans perceive.

The solution to this problem is to recognise that there are similarities between different families of property that justifies the description of them as colours even though these similarities are not internal relations of similarity between their determinates. The similarities in the low-level perceptual mechanisms of humans and pigeons, for instance, point to a similarity in the properties that is the function of these low-level perceptual mechanisms to detect: the physical light-affecting properties of material subjects. At this point we have not decided whether colours are identical with the physical light-affecting properties of objects, and indeed I shall argue later that they are not (Chapter 6). But even if colours are distinct from an object’s physical light-affecting properties, this does not disbar us from appealing to underlying physical properties to forge a connection between different families of colour property. As we shall see, naïve realists about colour do not generally think that colours simply ‘float free’ from physical properties. Indeed, there is good reason to suppose that even though they are *sui generis* properties, colours nevertheless bear a particularly intimate relationship to the light-affecting

³² 1988: 145.

³³ 1992: especially 334-7.

properties described by physical science: typically, that the former are metaphysically determined by, and so supervene on, the latter (§7.1). If colours do supervene on reflectances then at least this relationship offers a necessary condition for grouping properties together as colours: a family of determinate properties will count as colours only if it is metaphysically necessary that they supervene on an object's light-affecting properties.³⁴

Is the relationship of the properties different species perceive to the physical light-affecting properties of material objects all there is to being a colour? Perhaps not. Similarities in the perceptual mechanisms that realise colour experiences suggest that it may be possible to forge a still closer tie between human-colour and pigeon-colour than their relations to physical properties. In human colour vision, signals from the retinal receptors are opponently processed in three distinct psychophysical channels, realised by three distinct neurophysiological pathways. This opponent processing explains some particularly salient features of the phenomenology of colour experience, including the opponent structure of the colours and the related elemental/non-elemental distinction. Whilst a lot less is known about the neurophysiology of other species, there is some psychophysical evidence that the retinal signals in, for instance, honeybees, goldfish and pigeons are also opponently processed. Although the determinate colours represented in the colour experiences to which that this opponent processing gives rise may differ qualitatively to the human colours, it at least seems reasonable to suppose that these properties still exhibit the same *structural* properties as human colours: that they are opponently organised and can be divided into exclusive elemental and non-elemental categories.

It is unclear whether exhibiting structural features of this kind is a necessary condition of being a colour. It may be nothing more than a contingent fact of the colour properties that humans (and these other species) perceive that they are opponently organised. To the extent that we can conceive at all of what it would be like to experience colours other than those we actually experience, it seems that we can at least conceive of creatures perceiving properties that bear the relevant relation to the underlying physical properties, but which exhibit neither opponent organisation nor the related distinction between unique and derivative colours.

³⁴ Contrast Byrne and Hilbert Forthcoming, who object that: "unlike reductive realists (physicalists, in particular), there is no lower-level description of the colour properties that [naïve realists] can use to establish a kinship between the properties detected by [for example] goldfish and human vision".

But even if opponent organisation is not a necessary feature of colour properties, there is another feature of the phenomenology of colour experience that much more plausibly is: the perceived constancy of colour through changes in the conditions necessary for its perception. The value of colour perception for humans lies primarily in the relationship that it bears to our thought about a world populated by reidentifiable material objects. As I argue in Chapter 2, the perceptual constancy of colour is essential to our grasping the mind-independent existence of material substance. It is the perceptual constancy of colour that allows us to reidentify objects through gaps in our perception of them. Given the importance of this aspect of colour, it is reasonable to require that for a property to be a *colour* is for its perception play a comparable role within the cognitive economy of the perceiving subject. By this reckoning, different species do not count as perceiving colours unless the light-related properties that they perceive are constant throughout changes in the illumination, background, and so on; that is, unless those properties are implicitly regarded as mind-independent properties. Happily, many of the species to which we want to attribute colour vision – including bees, fish, and pigeons – do indeed appear to exhibit signs of colour constancy.³⁵

Generally speaking, the view that there is no way of grouping together properties as colours except via internal relations of resemblance belies an overly simplistic view of colour. It overlooks the essentially *bipartite* nature of colour: that, on the one hand, there are the internal relations in which colours stand and, on the other hand, the external relations that colours bear to other kinds of property. Setting aside possibly contingent structural similarities amongst the qualitative aspects of different types of colour, although the determinate colours that different species perceive may occupy distinct property spaces, they still deserve to be called colours if they occupy a similar functional role with respect to perceiving subjects.

³⁵ For an overview, see Neumeier 1998.

[5] Intra-Species Variation in Colour Perception

if by the different Structure of our Organs, it were so ordered, That the same Object should produce in several Men's Minds different Ideas at the same time; v.g. if the Idea, that a Violet produced in one Man's Mind by his Eyes, were the same that a Marigold produced in another Man's, and vice versa...he would be able as regularly to distinguish Things for his Use by those Appearances...I am nevertheless very apt to think, that the sensible Ideas in other Men's Minds, are most commonly very near and undiscernibly alike.

Locke 1690: II.xxxii.15.

It follows from the naïve view that colours are mind-independent properties that there is a sharp distinction between the colours objects appear and the colours they really are. Over the last two chapters I have been arguing that certain well-known facts about variation in colour perception do not undermine this commitment. Only differences in perceived colour between members of the same species now remain.

Intra-species variations in colour perception have long featured prominently in eliminativist arguments for the conclusion that no object is really coloured. Malebranche, for instance, argues that since people differ in the constitution of their sense organs, “it cannot be guaranteed that there are two people in this world having completely the same sensations of the same objects”, suggesting that this might even explain variety in aesthetic taste.¹ The standard philosophical response in the face of the eliminativist threat is no less well-known. This response is to regard variations in colour perception between humans as faultless disagreements in which there is no question of apportioning error. Relationists about colour do not hold the monopoly on this line of response, but the view that colours are relations between objects and perceiving subjects that differ depending upon the nature of their relata is by far the most popular version of this strategy.²

Consistent with the naïve conception of colours as mind-independent properties, however, we cannot accept the relationist's response to eliminativism. More generally, I argue in §5.1 that the eliminativist is right at least in thinking that intra-species variation involves *error*: that these differences are not just faultless disagreements. §§5.2-3 therefore consider the problem of apportioning error whilst

¹ 1674-5: 64-6, 441; although it should be noted that intra-species variation is not the only argument that Malebranche offers for this conclusion. Similar arguments are found amongst the ancient atomists, and more recently feature prominently in Hardin's arguments for eliminativism.

² Hilbert and Kalderon 2000 propose a non-relationist theory of colour according to which intra-species variations are faultless disagreements: for discussion, see §6.5. The view is more usually associated, however, with relationism. See, for instance, Locke 1690, and more recently McGinn 1983, McLaughlin 2003, Cohen 2005.

avoiding undue chauvinism. In effect, I argue that *all* colour perception within a certain range is equally unreliable on the grounds that the natural function of colour perception is really just to perceive mid-level determinable colours: inter-personal disagreements about super-determinate colours therefore arise when we use our colour perception in a way that transcends its natural function. The idea of the ‘natural function’ of colour perception is spelt out in more detail in §5.4, and §5.5 considers extreme cases of intra-species variation in which colours and colour experiences are systematically permuted. I suggest that we can resist the permutation argument if we clearly distinguish between conceptual and metaphysical distinctions: the distinction between colours and the way they appear is not a ‘real distinction’, but instead a mere ‘distinction of reason’.

1. Intra-Species Variation

For intra-species differences in colour perception to be faultless disagreements, the properties that different members of the same species perceive have to differ in kind. The problem for standard philosophical responses to inter-personal perceptual variation is to explain in what sense this is so. Consider, by way of illustration, a case of inter-personal variation in which one subject’s spectrum is shifted relative to another’s. Suppose, for instance, that Jack systematically locates the unique hues 5nms lower than Jill: whereas Jack locates unique blue – a blue that is neither reddish nor greenish – at 480nms, Jill locates it 475nms; whilst Jack locates unique green at 510nms, Jill locates it at 505nms; and so on. In what sense can we say that the properties that Jack and Jill perceive differ *in kind*?

These properties do not differ in kind in the way that I have argued that the colours perceived by members of different species differ in kind. The determinate colours Jack and Jill perceive both vary along the dimensions of determination, hue, saturation and lightness: the only difference between Jack and Jill is where in the visible spectrum they locate these colours. The properties they perceive therefore occupy different regions of the same property space. Assuming that sameness or difference of property-type is determined by sameness or difference of associated property space, this means that the properties that Jack and Jill perceive are

properties of the same kind: they are both determinates of the same determinable and so, it seems, mutually incompatible.

Given the role played by the similarity relations colour space represents in grounding our conception of colours as mind-independent properties in the first place, it is important that sameness or difference of property space should be sufficient to determine sameness or difference of property-type. I argued in Chapter 2 that it is essential to our conception of colours as mind-independent properties that we are able to think in relatively abstract terms about the internal relations of similarity and difference in which colours stand. But if properties that differ in kind can be located in structurally isomorphic property spaces, then thinking about the internal relations of similarity between colours will not uniquely fix the reference of our colour thoughts: it will not uniquely determine which properties it is that we ordinarily suppose objects to instantiate.

Now this might just show that the robust understanding of sameness or difference of property-type is too stringent, and therefore that colours are not mind-independent after all: at this point, it would beg the question to simply suppose otherwise. But can we substitute any weaker understanding of sameness or difference of property-type that can sustain the thought that the properties members of the same species perceive differ fundamentally in kind?

One possibility would be that sameness or difference of colour is determined by sameness or difference of the colour experiences with which they are associated. On this view, colours would differ in kind just in case the corresponding colour experiences differed in kind. But now the question is in what sense do the colour experiences of the spectrally shifted subjects like Jack and Jill differ in kind? They cannot be different simply in virtue of being experiences of different subjects, as this slices sameness or difference of experience-type too fine. Jack's colour experiences are not colour experiences of a different kind to Jill's simply because Jack and Jill are distinct perceiving subjects, any more than rain in Liverpool differs in kind to rain in London simply because Liverpool and London are different places. There has to be a relevant difference between the experiences themselves.

At this point, we cannot simply fall back on the claim that their experiences differ in kind because these experiences are experiences of colour properties that differ in kind. The relevant difference in the experience of the two subjects cannot

simply be an *extrinsic* difference in the properties that it is the function of their visual system to track. Whether we can make sense of the idea that Jack and Jill track different families of property is precisely what is at issue.

Any difference in their experiences sufficient to sustain the claim that the properties they perceive differ in kind has to be *intrinsic* to Jack and Jill. Now, their experiences do not themselves differ qualitatively: Jack has exactly the same kind of experience as Jill when he sees a spectral light that is neither reddish nor greenish, they differ just in which spectral light produces this experience. But there is at least a difference in the physiological mechanisms that realise Jack and Jill's experiences: perhaps there is a difference in the absorption characteristics of their retinal receptors, or in the way the signals from their retinal receptors are subsequently processed. Could it therefore be this difference in their physiological makeup that is the relevant difference between Jack and Jill? Unfortunately, this too raises problems.

For one thing, it also seems to slice sameness or difference of experience-type too fine. Just as rain in Liverpool does not differ in kind from rain in London merely as a result of subtle differences in the topology of Liverpool and London, it seems implausible that subtle differences in the physiological mechanisms that realise colour experience should produce colour experiences that differ fundamentally in kind. Differences in the perceptual mechanisms that explain the differences in the colour experiences of otherwise normal subjects do not seem significant enough to justify the description of these experiences, and the properties they are experiences of, as different in kind. It is much more natural to suppose instead that different subjects perceive, in slightly different ways, the very same property.

Besides, there is a deeper problem with the suggestion that the relevant difference between Jack and Jill lies in a difference in the physiological mechanisms that realise their experiences. To suppose that physiological differences are sufficient to generate a difference in the property-type that a subject perceives generates a problem about accommodating systematic misperception. Whether or not we want to treat differences in the location of the unique hues as cases of faultless disagreement, at least some inter-personal differences are clear-cut cases of misperception. Colour blindness is a case in point. Colour blindness is, in an

important sense, a genuine disability. It is not an especially far reaching disability, but it does impair an individual's performance. The inability to clearly distinguish reds and greens, for example, makes it difficult to discriminate objects from their backgrounds. In an ecological context, this makes finding food difficult, and in the modern world it effectively rules out careers in fashion, design and the armed services.³

The challenge for views that regard inter-personal variations in colour perception as faultless disagreements is to accommodate deficiencies in colour perception of this kind. If normal trichromatic subjects with shifted spectra perceive different kinds of colour property because of differences in the absorption characteristics of their retinal receptors, then why don't colour blind subjects also perceive different kinds of colour property? If a difference in a subject's retinal receptors is sufficient for a difference in the kind of colour property they perceive, then subjects who lack the relevant pigment from at least one of their types of retinal receptor altogether should also perceive colours that differ in kind. But this just seems wrong. The view that people who are colour blind perceive colours that differ in kind to those perceived by normal trichromatic subjects is political correctness gone mad.

The flip side of the problem about accommodating disagreement is a problem about acknowledging inter-personal *agreement*. It is not just the amount of inter-personal disagreement in colour perception that is striking, but the extent to which our colour perception accords with that of other people. Although normal trichromatic subjects often disagree about super-determinate colour properties, they far less frequently disagree about the mid-level determinables under which objects fall. Jack may see a certain Munsell chip as green, and Jill see the same chip as a slightly bluish-green, but Jack and Jill at least agree that they see a Munsell chip that falls under the mid-level determinable green. The view that different members of the same species perceive colours that differ in kind, however, threatens the very possibility of this sort of agreement. If the colours that Jack perceives differ in kind from those perceived by Jill then why aren't these properties simply incomparable?

³ Although Mollon 1989: 382 mentions the case of a red-green colour blind protanope who, after colour blindness put pay to his career in the textile industry, decided to become an orchardist instead! For a more extended discussion of colour blindness, see §4.3.

This generates a knock-on problem for Jack and Jill's ability to communicate about colour. If sense is even at least in part determined by reference, then Jill will mean by 'green' something different to Jack: Jill will use 'green' to refer to the property that she perceives Irish post-boxes to be, whilst Jack will use 'green' to refer to a property of Irish post-boxes that differs in kind from the property perceived by Jill. How, then, can Jack and Jill communicate about the colour of Irish post-boxes at all?

Generally speaking, the more the difference between the properties that different members of the same species perceive is stressed, the more difficult it becomes to understand comparisons between, and communication about, the colour experiences that different subjects enjoy. Playing down differences in the colours that different members of the same species perceive avoids this problem. But it does so at the expense of making it difficult to sustain the thought that the properties these subjects perceive really differ in kind at all. And if they do not really differ in kind, then inter-personal differences in colour perception cannot just be faultless disagreements. The different colours objects appear to different members of the same species will after all be incompatible.

2. Sexism, Racism and Ageism

The fundamental difference between inter- and intra-species variation appears to be that questions of *error* arise in the latter case but not in the former. Whereas disagreements between members of different species are faultless, disagreements between members of the same species are not. It is, however, at this point at which things start to become uncomfortable.

Variations in the colour perception of otherwise normal members of the same species depend on differences in physiological makeup that are systematically determined by age, sex and race. As we get older, for instance, the lens of the eye gradually absorbs more short-wavelength light, preventing this light from striking the retina. The result is that we become progressively less sensitive to blues and greens: purples, for instance, begin to look redder as the amount of blue they are

perceived to contain is reduced.⁴ Independent of this, the peak sensitivities of the three types of human retinal cone vary depending upon the genetic makeup of an individual in a way that is systematically linked to sex. Across the male population, the long-wavelength cones vary in their peak sensitivity by between 5-7 nms. The average peak sensitivity of long-wavelength cones in women is intermediate between these extremes. Although the relationship between retinal absorption rates and colour experiences is not straightforward, given that differences at the retinal level can be off-set by subsequent differences in the processing of the retinal signals, these differences can be detected using Rayleigh tests, in which subjects use an anomaloscope to colour match two halves of screen lit by two different lights, one a mixture of red and green, the other yellow or orange: subjects who differ in the peak sensitivities of their cones make different colour matches in these tests. Still further differences, this time linked to race, occur in the spectral sensitivity curves of different subjects's retinal receptors.⁵ Can we apportion error in light of these differences whilst avoiding undue chauvinism?

The first thing to say is that these cases are not all on a par. Variations in perceived colour that are linked to age are the least worrying. It is a common place that many of our natural faculties deteriorate as we age, and our perceptual faculties are no exception. I am myopic. Because my eyeballs are too long, my lenses too strong, or possibly both, the lenses in my eyes bring light rays to a focus in front of my retina. As a result I am unable, unaided, to clearly perceive objects that are any more than a few feet away from me. This condition is not one that I had when I was a child, and is one that has worsened as I have grown older. Indeed, if this condition does not continue to worsen as I grow still older, this will only be because it happens to be corrected by a different visual defect: presbyopia. As ageing occurs, most lenses lose their elasticity, making them unable to bring the light entering the eye from short distances into focus on the retina: the light is brought to focus behind the retina instead. The result of this defect is that unaided near vision becomes almost impossible.⁶

Given that in general our visual system deteriorates as we age, it seems reasonable to suppose that it will also deteriorate with respect to fulfilling its colour

⁴ Kaiser and Boynton 1996: 459-60.

⁵ For an overview, see Block 1999.

⁶ Palmer 1999a: 28.

perceiving function. If so, then it is not unreasonable to treat as a defect the change in colour perception that occurs when increasing amounts of short-wavelength light are absorbed by the lens. It is hardly ageist to acknowledge that as we get older, we are no longer able to do, to the same standard, many of things that we were once able to.

The problems of sexism and racism, however, can be dismissed so easily. When it comes to variations between normal trichromatic human subjects that are systematically determined by sex and race we seem genuinely unable to privilege the colour perception of one section of the human population over any other without simply playing favourites. There appears to be no reason to regard any section of the community as *the* correct colour perceivers. Still, this problem does not establish the eliminativist conclusion that no object is really coloured at all; that the colours we perceive are all equally apparent.

For one thing, the naïve view that colours are mind-independent only entails that there *is* a sharp appearance-reality distinction, not that the distinction is one that we should expect to be able to draw. If colours are genuinely mind-independent properties, then there has to be a fact of the matter about which super-determinate colour property an object instantiates. We might even expect at least some members of the species that track the determinable of which this property is a super-determinate to sometimes perceive objects to be the super-determinate colours they really are. But it does not follow that we must be able to *know* of any given perceiving subject that their super-determinate colour perception is veridical. This may just be an unknowable fact.

Postulating the existence of unknowable facts about colour may seem like an *ad hoc* attempt to save the mind-independence of colour in the face of an insuperable problem.⁷ But this overplays the problem. It is, for instance, consistent with the existence of unknowable facts about colour that there are plenty of colour facts that we can know. Although we might not know what super-determinate colours objects instantiate, we might at least be able to know under which higher-level determinables these objects fall. Indeed, there may even be reason to suppose that it is only a more or less narrowly circumscribed class of colour facts like these that we

⁷ In response to a similar suggestion made by Byrne and Hilbert, for instance, Hardin remarks that “there is at least a whiff of ether here, the electromagnetic ether whose undulations were supposed to be mechanical basis of electromagnetic phenomena”, 2003: 32.

should expect to be able to know. Perhaps making judgments about the super-determinate properties of objects employs the visual system in a way that transcends its *natural function*.

A system's *absolute* functional limit is that point beyond which the system cannot fulfil its intended function to any greater degree. For instance, if my car cannot travel at more than 120 miles per hour in optimal conditions, then 120mph is its absolute functional limit. *Optimal* functional limits, in contrast, are those points after which a system just ceases to work efficiently in the manner intended. Even though 120mph may be car's absolute functional limit, for instance, if after 70mph there is a marked deterioration in its road handling, it starts to shake violently, or if bits of it begin to fall off, then 70mph is my car's optimal functional limit as a safe, comfortable, reusable means of transport. Carrying this distinction over to colour perception, we can say that the absolute functional limit of the visual system is represented by the total number of super-determinate colours a subject can perceive in optimal conditions, and hence the total number of colour distinctions the subject is able to make in those circumstances. The optimal functional limit of colour perception, however, may lie well within this range. Indeed, the optimal functional limits may lie just at the level of determinable colours like scarlet, cherry red and vermilion, or perhaps even red, yellow, green and blue: although we may reliably perceive objects as falling under mid-level determinable colour properties like these, perhaps our perception of the super-determinate properties that fall within the extensions of these mid-level determinables is just inherently unreliable.

To take a concrete example, suppose that the extension of the mid-level determinable scarlet is the set of super-determinate properties, red₁-red₁₅. By virtue of perceiving an object that is really red₇ as instantiating *any* of the super-determinate properties in this range, you veridically perceive the object as scarlet. Clearly, this is consistent with misperceiving its super-determinate colour: if, for instance, you perceive the object as red₃. Indeed, even if you perceive the object as falling under both the determinable scarlet and the super-determinate red₇ – and hence you experience is veridical both at the level of determinables and determinates – this experience may still be essentially unreliable. If in perceiving the object to be red₇ you go beyond the optimal functional limit of your visual system, your beliefs about the object's super-determinate colour are true only by good fortune. The nature of

your visual system does not warrant these beliefs, because consistent with your having this kind of visual apparatus you could have perceived the object as some other super-determinate property in the relevant range.⁸

The crucial question is just whether it makes sense to think of the visual system in this way. Is it plausible to suppose that the visual system is accurate just to the level of mid-level determinables like scarlet or red? If it is, then this will offer a response to intra-species version of the Argument from Perceptual Variation.

3. The Limits of Colour Perception

The proposal that colour perception amongst otherwise normal trichromatic subjects is even accurate to the level of determinables may seem to be blown out of the water at the very outset by striking variations in the location of the unique hues: hues that appear to contain no trace of any other colour. In a study into the spectral location of unique green by Scheffrin and Werner, for instance, subjects located unique green anywhere between 486nms and 535nms, with some otherwise normal subjects seeing as unique green a spectral light that other subjects perceive to be unique blue. Does this mean that there is inter-personal disagreement even at the level of colour determinables?⁹

We need to approach these findings with caution. For a start, the study by Scheffrin and Werner into the spectral location of unique-green is intended to show the variation of the location of unique green with age, and so the study includes data from subjects aged between 13-74 years. We have already seen, however, that colour perception deteriorates with age, especially in the shorter wavelength region of the visible spectrum in which unique green is located. More importantly, we have already suggested that there is a non-arbitrary reason to prefer the colour perception

⁸ Suppose, by analogy, that I am able to assign essays into broad classes, but am unable to accurately grade essays within these boundaries. So, for instance, suppose I can tell whether or not an essay deserves a 1st class mark, but am unable to tell specifically whether it deserves a mark of 71%, 72%, or 73%. Now I can assign it one of these marks, indeed I may have to assign one of these marks because of the nature of the marking enterprise, and what's more, I might even assign it the right mark. But if I do happen to assign it the right mark, this is down to luck, not judgement. Although my judgement is not as a matter of fact erroneous, neither is it reliable. In assigning the essay the mark that I do, I go beyond the limits of my optimal functional capacity to grade essays: as an 'essay grading system', I am accurate only to the level of class marks.

⁹ Scheffrin and Werner 1990. This study is referred to by both Hardin 1988: Preface to Second Edition and Block 1999.

of younger perceivers in this respect (§5.2). We can therefore disregard the more extreme variations in the location of unique green that Schefrin and Werner report. Unsurprisingly, studies into the spectral location of unique-green based on a more restricted sample, though still shocking, are much less so. In a classic study by Hurvich, Jameson and Cohen, for instance, subjects located unique green anywhere between 490nms and 517nms, which only (!) represents 9% of the visible spectrum, in contrast to the 13% across which Schefrin and Werner's subjects located it.¹⁰

Unique green is anyway a special case. On the one hand, unique green and unique blue are much more similar to each other than either is to the adjacent unique hue (see §6.1). This means that less variation is needed for their spectral locations to overlap. On the other hand, even amongst the unique hues inter-personal variation in the spectral location of unique green is uncharacteristically extreme. Discounting unique red, which is a non-spectral colour, inter-personal variations in the location of unique blue and yellow are far less pronounced. In Schefrin and Werner's study, for instance, subjects located unique blue between 462-496nms and unique yellow between only 566-588nms: this represents less than 9% of the visible spectrum for unique blue and less than 6% of the visible spectrum for unique yellow, compared to the near 13% they found for unique green.¹¹

At least in part the explanation of why unique green is a special case is that the region from around 510nms to 550nms is a region of poor hue discrimination, in which differences in wavelength do not translate into differences in perceived colour. For instance, 494-557nms – a difference of 63nms – corresponds to seven equally spaced Munsell chips: chips between which there are approximately equal differences in colour. In contrast, 572-586nms – a difference of just 14nms – corresponds to five perceptually equally spaced Munsell chips.¹² This averages out to 9nms per Munsell chip in the green part of the visible spectrum, in contrast to just 2.8nms in the yellow part. The comparative paucity in hue discrimination in this region is reflected in the fact that subjects tend to be more sensitive to departures from unique green at shorter wavelengths than at longer wavelengths: the light most frequently identified as unique green is therefore usually closer to the lower-limit

¹⁰ For details, see Hurvich 1981: Chapter 16.

¹¹ These results are subject to the same qualification as the results for unique green: the sample base includes subjects whose colour vision has been detrimentally affected by the aging process. This would affect the results for unique blue in particular.

¹² Hardin 1988: 160-1.

than the upper-limit. In the original Hurvich *et al* study, for instance, unique green was most frequently located at around 503nms, with a lower limit of 490nms (-13nms) and an upper limit of 517nms (+14nms). In a more recent study by Jordan and Mollon, unique green is most frequently located between 505-10nms, with a lower limit of around 485nms (-20 nms) and an upper limit of about 560nms (+45nms)!¹³

Differences in the spectral location of the unique hues raise a more general point. It is only under controlled conditions that inter-personal variations in colour perception are evident. The standard way of identifying differences in the peak sensitivities of the three human cone types mentioned in §5.1, for instance, is by using an complicated and expensive instrument called an anomaloscope, in which subjects make two halves of a screen match in colour using different lights: one a mixture of red and green, the other yellow or orange. Tests to determine where a subject locates the unique hues are carried out under equally strict conditions, using equally sophisticated instruments. Indeed outside of the laboratory, even the very significant variations between trichromatic and dichromatic colour perceivers can go unnoticed for a very long time. Why this should this be?

There are reasons specific to the location of unique hues why inter-personal differences generally go unnoticed. In the natural environment it is actually highly unusual to perceive the kind of monochromatic light used in unique hue experiments.

Most natural light is full spectrum light, in the sense that it is composed of light from each and every visible spectral wavelength. Correspondingly, most material objects reflect at least some light from every part of the visible spectrum, and so most of the light that reaches the eye is broadband spectral light (see §3.4). One explanation of why differences in the spectral location of the unique hues should only be evident in carefully controlled conditions is therefore that widespread variation in these non-standard conditions is consistent with more general agreement under normal conditions.

Jordan and Mollon, for instance, found that variations in the location of unique green are correlated with differences in the lightness of a subject's iris, something which is usually thought to be linked to the amount of pigmentation in

¹³ Jordan and Mollon 1995.

the fundus of the eye, behind and between the retinal receptors. Eyes with heavier pigmentation in their iris tend to absorb more short wavelength light, changing the spectral composition of the light striking the retinal receptors. Jordan and Mollon suggest that the visual system normally compensates for these differences in its subsequent processing, and that this habitual compensation might explain the differences in the spectral location of unique green that we find. If, for instance, two subjects with differently pigmented eyes both perceive a real world object as unique green, there will be a difference in the ratios of the signals emitted by their retinal receptors consequent upon the difference in the light striking these receptors. Although there will be no difference in their output ratios when they perceive a monochromatic green light – the heavier pigmentation only affects the shorter wavelength light that enters the eye – if their visual systems are already differently calibrated then they will respond to this identical output differently, resulting in the differences in the spectral location of unique green that we find in the laboratory. Differences in the location of unique green in non-standard conditions will therefore be a consequence of the visual system's attempts to veridically perceive the colours of more common broadband stimuli.¹⁴

There is a more general reason – not specific to the spectral location of the unique hues – why inter-personal variations in colour perception are only evident in highly circumscribed conditions. This is because it is only under carefully controlled circumstances that an individual's colour perception, and the judgements they make on the basis of this colour perception, are sufficiently exacting to ground colour judgements that conflict in the first place. Hardin, for instance, estimates that a trained, normal observer, can discriminate up to ten million surface colours in optimal conditions.¹⁵ In the less than optimal perceptual conditions found in the real world, however, the number is nowhere near this amount: it may even be less than a few thousand.¹⁶

Colours that are discriminable to a subject under specially circumscribed conditions can be indiscriminable to the very same subject in other conditions. The strength of the illumination, the viewing distance, the distance between the samples, the angle of the samples with respect to both the viewer and the illumination all

¹⁴ Jordan and Mollon 1995.

¹⁵ 1988: 182. Others put the figure slightly lower than this, although it is generally over 1 million.

¹⁶ Sivik 1997: 163.

make a difference to our discriminative abilities. Colours between which there is a just noticeable difference when juxtaposed, for instance, immediately appear identical in colour when we move them apart by even a few centimetres: as the distance between the colour samples increases, so does the difference in the colour of the samples necessary to distinguish them.¹⁷ Our ability to discriminate colours also decreases with the intensity of the illumination. In low intensity illumination, for instance, red is indistinguishable from blue. Nagel, in an Appendix to Helmholtz's *Treatise on Physiological Optics*, for instance, notes that "In dim twilight the cap of a German infantryman, which is blue with a red band, does not look different from that of sanitary officer with its dark blue band".¹⁸ Indeed, if you look at a magazine or newspaper in still lower intensity moonlight, it is difficult to tell whether its pictures are chromatically coloured (whether they are 'in colour') at all.¹⁹ Given this range of factors that affect our discriminative abilities, it is therefore no accident that the *Munsell Book of Color* – the most famous colour atlas, and often used for testing inter-personal variations colour perception – comes with very strict guidelines for the conditions under which its coloured chips should be viewed. Samples, for instance, should be perceived against a dark achromatic background, using "north daylight" (daylight from a lightly overcast north sky) or its artificial equivalent (scientific daylight with a colour temperature of 6500-7500K). The samples should be viewed at 90° (i.e. perpendicular to the line of sight) and illuminated at 45°, or the exact opposite, and so on.²⁰

Facts about the perceiving subject are no less important when it comes to colour perception and discrimination. Although it is a perfectly natural ability, as with most natural abilities, our capacity for discriminating colours improves with practice: it improves 'as we get our eye in'. The normal observer that Hardin estimates can discriminate up to ten million surface colours, for instance, is "trained". But just as a sommelier will be able to distinguish tastes in wines that to the untutored palate are indiscernible, someone who works, for example, in the

¹⁷ Sivik 1997: 163.

¹⁸ 1911: 357. This is called the *Purkinje Phenomenon*.

¹⁹ Kaiser and Boynton 1996: 38. The spectral power distribution of moonlight is broadly similar to that of direct sunlight (perhaps a little yellower), but a lot less bright: a full moon on a clear night has a luminance that is only just over half that of a 40W fluorescent tube. Henderson 1977: 228-30.

²⁰ For details, see Hardin 1988: 68.

design industry will be able to make much finer colour distinctions than someone whose everyday life does not involve poring over colour samples.

Cross-cutting questions about training are issues about attention. When performing psychological studies designed to test colour perception, subjects pay much greater attention to an object's colour than is usually called for in everyday life. The Farnsworth-Munsell 100-Hue Test, for instance, in which subjects are asked to arrange (as it happens) 85 different hue samples to form a continuous series of colours, takes between 15 and 30 minutes to administer.²¹ The attention to colour that this involves is therefore much greater than that which is involved when, for instance, glancing out of my window, I see that there are two red cars and one silver car parked on the other side of the road.

Although inter-subjective differences in our very precise judgements about super-determinate colour properties can have important consequences for industry and commerce, the industrial and commercial uses of colour vision are not the uses for which our colour vision evolved. Colour vision evolved in a natural environment, to fulfil certain practical needs of perceiving subjects. But these practical needs do not in general include the ability to make accurate judgements about an object's super-determinate colour. Consider again the uses of colour vision discussed in arguing that our conception of colour is a conception as of a mind-independent property in the first place (§2.3).

One of the uses of colour perception is to partition the visual scene into discrete material objects. The common colour of different parts of a visual scene serves as the basis for treating these parts as parts of the same object. Glance at an article of clothing that you are wearing. On the basis of this experience, you form a belief about the colour of the article that partly serves to individuate the garment: roughly, you perceive the garment as extending as far as its colour does. For the purposes of fulfilling this function, however, it is best that your colour perception is not too precise. Look at the garment again, this time in more detail. Where the fabric creases, parts of the garment will be in shadow, causing clearly perceptible differences in the colour the different parts of it appear to be. What looked at first glance to be homogeneously coloured, looks on closer inspection to have a more variable appearance.

²¹ Kaiser and Boynton 1996: 431-3.

If, as a matter of course, we perceived super-determinate colours, then we would not expect to generally see objects as homogeneously coloured. But clearly we do. It is only by focussing our attention that we even notice the differences in colour appearance. It is partly this that makes painting so hard: you have to train yourself to perceive detailed differences in the colour appearance of an object that otherwise go unnoticed; you have to train yourself to discriminate between parts of the visual scene that are at first blush indiscriminable. As the art theorist Baxandall says in attempting to attend to the shadows on the walls of his study:

What I do not do, or would not be doing but for a special interest, is to attend to the individual microshadows as shadows or as objects of perception in their own right. If I attend to part of a wall I get a sense of its surface quality and that seems enough. Even with a special interest, it takes an effort of will, a decree of the mind, to attend to the same area of wall, to categorise its shadow types, and read the bearing of their light...[to do so] seems to go against the grain of the perceptual process.²²

Baxandall is right that it 'goes against the grain' of the perceptual process to discriminate local variations in colour appearance. If our colour perception was generally this precise, then it could not fulfil its segregative function.

A similar point applies when we move from the segregation of the perceptual scene to the identification of objects within the scene. One of the advantages of colour vision is that it facilitates the detection of objects against their background: as we have already seen, one of the things that people who are colour blind bemoan is that their inability to discern objects with the same ease as their normal trichromatic counterparts. In an ecological context, for example, trichromatic human colour visions allows us to perceive red apples against the background of green foliage. For apples to 'pop out' from their background, however, it is at best unnecessary to perceive the super-determinate colour of either: it is sufficient to perceive a bare difference at the level of determinables between the green foliage and the red apple. To perceive the super-determinate colour of either may even be a positive

²² Baxandall 1995: 125-6. Compare Merleau-Ponty's description of the way the sheets of paper lying on the table in his study appear when some are in the light and some in shadow: "If I do not analyse my perception but content myself with the spectacle as a whole, I shall say that all the sheets of paper look equally white. I decide to look more closely. I fix my gaze upon them...the sheets change their appearance: this is no longer white paper over which a shadow is cast, but a grey or steely blue substance...If I once more look at the general picture, I notice that the sheets over which a shadow is thrown were at no time identical with the sheets lying in the light, nor yet were they objectively different from them. The whiteness of the shaded paper does not lend itself to precise classification within the black-white range. It appeared as no definite quality", 1945: 262-3.

distraction: it is information about the environment that is irrelevant to the task at hand.

It is interesting in this respect to note that the spectral sensitivity of the cone-types that determine the signal in the red-green opponent channel overlap substantially: **M** cones are sensitive to light from roughly 430-640nms, and have a peak sensitivity at 530nms, whilst **L** cones are sensitive to long-wavelength light, from roughly 450-700nms, with a peak sensitivity at 560nms. The close spacing of these receptors minimises the available information about the reflective behaviour of objects in this region of the spectrum: it takes a larger difference between an object's reflectance in the middle and high ends of the spectrum to make a difference to the signal in the red-green channel. This facilitates the detection of objects that differ markedly in their reflectances in these parts of the spectrum – as red and green objects do – by obscuring differences between objects that vary less dramatically. As Nagle and Osorio suggest, differences between green objects may therefore be a kind of 'spectral noise' that our colour vision has even evolved to ignore.²³

Colour vision is not just valuable in allowing us to distinguish objects from their background, but is useful in visual search tasks more generally. Colours greatly improve our abilities in visual search tasks where the aim is to identify one object, or group of objects, amongst many that lie in the same plane. But again, it is not by perceiving differences at the level of their super-determinate colour that we are able to distinguish objects in this way. Considering the use of colour displays in aircraft cockpits, for instance, Krebs and Wolf caution designers to resist the temptation to use the full gamut of available colours, finding that the more colours are used the harder it becomes for the operator "to make a decision about the colour of a given symbol". Krebs and Wolf suggest that in fact no more than five colours should be used – preferably just three or four – and that the colours should be widely spaced across the visible spectrum: for instance, blue, green, yellow, red, with orange as a possible fifth.²⁴ The implication of this is that when our attention is focussed elsewhere we perceive colours only ever so broadly speaking: we are insensitive to differences at the level of super-determinate colour.

²³ Nagle and Osorio 1993.

²⁴ Krebs and Wolf 1979.

Nor does the importance of colour in assigning already identified objects into categories typically depend upon the possibility of maximally determinate colour perception. Consider the use of colour as a guide to the internal constitution of an object, as when we judge whether or not a piece of fruit is ripe on the basis of its colour. We don't need to know what specific shade of yellow a banana is to know that it is ripe: it's enough to be able to see that it instantiates a determinate of the determinable yellow, and not a determinate of the determinable green.

The same is true when it comes to the role of colour in the reidentification of material objects. If we want to know whether an object persists through time, then one of the ways that we can do this is by reference to its colour: if, for instance, a piece of paper on the floor is the same colour as the piece of paper that I left on the table before, then this may be sufficient to ground my belief that it is the same piece of paper, but that it has fallen off the table in the meantime. But again it is not with reference to an object's super-determinate colour that we determine whether or not it persists through time. There is a significant and systematic phenomenon called *colour memory shift*, whereby subjects appear to remember only the determinable property that objects instantiate. Bodrogi and Tarczali conducted experiments in which subjects were presented with a colour stimulus, and after an interval of time t – generally a few seconds, although at least more than one second – during which the stimulus was removed, were asked to identify which, of a number of colours, the colour they perceived was. Bodrogi and Tarczali found a systematic shift during interval t , with observers choosing a more prototypical version of the colour that they originally perceived. Particularly pronounced was the shift towards 'focal colours': colours that are generally named in the shortest possible time and with consensus by many different observers, and which are located within the regions of colour space occupied by the eleven basic colour categories with monolexical colour names, red, pink, purple, blue, green, yellow, orange, brown, white, grey and black.²⁵

The cognitive significance of these broad colour categories is further reflected in the linguistics of colour terms. The words used to name the eleven basic colour categories form a hierarchy famously described in Berlin and Kay's *Basic Colour Terms*. In their evolution, all languages pass through the hierarchy via a

²⁵ Bodrogi and Tarczali 2002, Wyszecki and Stiles 1967: 400. Monolexic colour words are those words whose meanings are not a function of that of their parts. So, whereas 'dark blue' is polylexic, 'blue' is monolexic.

“permissible route”. They start with the two colour terms black and white; red comes next; the fourth and fifth colour terms in either order are green and yellow; then comes blue; this is followed by brown; and finally, in no particular order, we get purple, pink, orange and grey.²⁶ As languages continue to evolve the number of colour terms they accrue multiplies, reflecting the changing needs of the members of the linguistic community. The terms that name the basic colour categories, however, retain their centrality. Indeed, from a communicative point of view, this is precisely what we should expect. As Locke stresses, the point of general terms is to facilitate communication. They cannot do this if they are too numerous: in this case, ‘the multiplication of words would perplex their use’.²⁷

Reflecting this, Corbett and Davies found in a study of colour word usage that the list of the most frequently used colour terms in the one million word Lancaster-Oslo/Bergen corpus for British English by and large follow the evolutionary hierarchy for basic colour terms. In order, the top ranking colour terms are white, black, red and green. Skipping yellow which is ranked eighth, blue comes next, followed by grey and brown in seventh place. The last three are pink, purple and orange. The three non-basic colour terms used most frequently – silver, bronze and scarlet – all beat the lowest ranking basic colour term, orange, and silver also beat the next lowest ranking basic colour term, purple. Corbett and Davies note that the results for silver and bronze may anyway be overestimates of their use as colour adjectives. Still, with just 22 uses, the most frequently occurring non-basic colour term silver comes nowhere near the top ranking basic colour terms, the first six of which all score over 80, with the top ranking term, white, occurring no less than 247 times.²⁸

An increasingly popular sub-personal explanation of the salience of determinable colours is that the output of early colour processing is classified into *cognitive* or *internal* colour categories. Cognitive colour categories occupy discrete regions of perceptual colour space – although jointly they need not cover the entire colour space – and they differ in number depending upon the nature of the visual task. In total they may number no more than thirty, but they generally include the eleven basic colours, or at least some subset of these. The classification of the

²⁶ Berlin and Kay 1969; for recent discussion, see Corbett and Davies 1997.

²⁷ 1690: III.i.1; cf III.iii.

²⁸ Corbett and Davies 1997.

output from the visual processing mechanisms at a sub-personal level into cognitive categories determines the information that is available downstream, and ultimately at the personal level. If, for instance, the cognitive categories into which the output from the visual processing mechanism feeds are very broad, then only very limited information about the object's colour will be available to the subject. In effect, the storage of signals from the early visual processing mechanisms in this way dramatically reduces the information about an object's colour that is available to the subject. It is like storing the class marks to a group of essays without storing the percentage marks on which these class marks are based: once you have assigned the essays into classes and dispensed with the original percentages, there is no way of distinguishing between different essays within a class short of going back and remarking them in the more precise terms.²⁹

In controlled conditions, then, the *absolute* functional limit of colour perception is about ten million colours. In everyday life, the number of colours that we can perceive drops sharply, with the absolute functional limit in these conditions standing at just a few thousand. The *optimal* functional limit of colour perception, however, is even lower still: it is probably just somewhere between 11 and 30. The colour properties that have cognitive significance for colour perceivers are relatively high-level determinable properties that occupy large regions of colour space. From the perspective of the colour perceiver, individual differences in super-determinate colours that are located in the same region of colour space are not generally important and even tend to be obscured in the cognitive process itself. So long as we perceive objects as correctly falling into the broad colour categories that have cognitive significance for us, it is irrelevant whether or not our very specific colour perceptions are veridical. Crucially, there *is* this broad inter-subjective agreement about the determinable colours of material objects: at the level of determinable colour properties, variation amongst otherwise normal trichromatic humans is negligible.

²⁹ In response to the phenomenon of memory colour shift, for instance, Bodrogi and Tarczali 2002 suggest that a “discrete recoding” of colour perception may be taking place, in which the perceptual colour is assigned to a colour category and only the category is remembered. For a recent, very useful, discussion of cognitive colour, see Derefeldt *et al* 2004.

4. The Natural Function of Colour Perception

I have been arguing that inter-personal variation in our very precise colour experiences arises because it goes beyond the natural function of our colour vision to perceive the super-determinate colours of objects: the function of colour vision is only to assign objects into broad colour categories; it is only to discover the general colour properties that they instantiate. This avoids the problem raised at the beginning of §5.2: the problem of acknowledging error whilst avoiding chauvinism. At the level of super-determinates colour perception is equally unreliable across the *entire* species. At the level of determinable colour there is no substantial inter-personal disagreement.

This, however, helps to bring into sharper focus an underlying worry that we might have. The response to inter-personal variations in colour perception relies heavily on the idea of the *natural function* of colour perception. In order to know what the natural function of colour perception is, however, we need to know what properties it is the function of colour perception to track. But unless we already know that the visual system is functioning correctly, we have no way of knowing which properties it is the natural function of colour perception to track. There is a circularity: the proper functioning of the visual system is assessed in terms of the properties it is the function of the system to track and the properties it is the function of the system to track in turn determined by the nature of the visual system. How, on this view, could we ever step outside the circle to find out that a visual system was functioning correctly in the first place?

It appears to be something like this problem that underlies Michael Smith's objection to John Campbell's naively realistic 'Simple View' of colour, according to which colours are categorical properties whose nature is "transparent" to us. Smith writes:

what vindicates our ordinary classification of shape and size as categorical properties is the fact that we can canonically determine the shape and size of an object by (correctly) measuring its various sides and angles. It is this that guarantees the independence of facts about shape and size from facts about shape and size appearances. But what is the analogue of this kind of canonical method in the case of colour? More to the point, what is the analogue if the 'real nature' of colour is supposed to be 'transparent' to us in colour

experience: that is, if ordinary perception is supposed to be enough to know *which* properties are referred to by our colour terms?³⁰

Smith's specific worry is that there will be no way of verifying the deliverances of colour experience if, like Campbell, we suppose that colours are mind-independent properties whose entire nature is revealed in visual experience. The objection, however, has wider application. The most plausible physical candidates for the colours are types of reflectance property, identified with reference to visual experiences of colour (see §6.3). Although we can at least measure reflectance properties using a spectrometer, if the only way of delineating these reflectances into kinds is with reference to visual experiences of colour, then there will be no independent way of checking the deliverances of experience in this case either. If colours are mind-independent properties of *any* kind, then there will be no other means of settling disputes *but* by appealing to the best judgements of perceiving subjects.

But then why is this a problem? Smith claims that there is no canonical method of determining an object's colour in the way that there is for determining an object's shape: there are, for instance, no chromatic equivalents of set-squares. But why can't there be different canonical methods proper to different properties? Consistent with the mind-independence of colour, for instance, why couldn't looking in optimal conditions just be the canonical method for determining an object's colour? As Warnock remarks in response to Berkeley's use of the Argument from Perceptual Variation:

If a piece of paper looks red in a strong red light and green in a green one, and if it looks white when held near a plain glass window at midday, then undoubtedly that piece of paper is white...there is a difference in the *methods* of drawing the distinction [between appearance and reality in the case of primary and secondary qualities]...In some cases we measure or count, in others we look again in standard, ordinary normal conditions.³¹

The objection against the naïve view that colours are mind-independent suggests a deeply ingrained suspicion of the senses. It is only insofar as we think of

³⁰ 1993: 272. Similarly, Cohen complains that although ovoid objects can look round, we have criteria for ovoidness that is independent of the way ovoids look: "In stark contrast to these cases, we lack (non-stipulative) perception-independent criteria for the colors of things; therefore, unlike the case of perceptual variation with respect to *being ovoid*...the case of perceptual variation with respect to color is unresolvable without *ad hoc* stipulation", 2005: §2.4.

³¹ 1953: 98-9.

the senses as inherently unreliable that the absence of an independent means of determining an object's colour really represents a cause for concern: it is because of a deep-seated mistrust of sensory experience that we feel the need for something, as Smith puts it, to "guarantee" the deliverances of our otherwise wayward sensory faculties. The limits with respect to our most precise colour judgements notwithstanding, however, why accept this assessment of our epistemic situation? It begs the question to simply take it as a datum that the senses are inherently unreliable, as whether humans at least veridically perceive an object's determinable colour is precisely the point at issue. Moreover, we have already seen that there *is* – at least as a matter of empirical fact – broad inter-subjective agreement about the determinable colours of objects.

It is clearly true that if we lack any means of determining colour other than looking in optimal conditions then we can never conclusively verify that the colours objects appear in daylight at a viewing distance that is neither too near or too far are the colours they really are. But as Descartes's method of doubt teaches us, if what we want is conclusive verification, then size and shape are ultimately on no better a footing than colour. The canonical method for determining an object's size and shape described by Smith is no less subject to hyperbolic doubt than the canonical method for determining an object's colour. Suppose that we want to know whether an object that looks square really is square, and so we follow the procedure suggested by Smith of measuring its various angles and sides. If we are seriously entertaining doubt about the deliverances of our senses, then *perceiving* that the square has four angles that are each 90° when we measure them with a set-square should not be sufficient to satisfy our curiosity. What if it the square only *appears* to have four sides, or its angles only *appear* to measure 90° ?

It is important to bear in mind the extent to which the standing presupposition *against* the reliability of the senses is just an artefact of the post-Cartesian outlook. It hasn't always been this way. Suspicion of the senses, especially with respect to secondary quality perception, is largely a legacy of seventeenth century mechanism, and contrasts, for instance, with earlier Aristotelian views of perception. According to Aristotle, properties like colour and sound are *always*, at least in the relevant conditions, veridically perceived. Because colour and sound are special sensibles – they are properties which are perceived only by one sensory

modality – colour and sound are the properties it is the specific function of our visual and auditory sensory modalities to perceive. It is therefore precisely *because* there is no way of determining an object’s colour other than looking and seeing that we are entitled to assume that our colour perception, under normal conditions, is veridical. If these senses are functioning correctly, then in the natural circumstances optimal to their performance, they are incorrigible: there is no better standard by which to judge of colour or sound, and no other method is even necessary. Special sensibles contrast, in this respect, with common sensibles like shape and size that we can perceive via more than one sensory modality. The very fact that we can perceive these properties via more than one sensory modality shows, according to Aristotle, that error in our perception of the properties is possible. Indeed, it is precisely *because* our visual perception of these properties is liable to error that independent checks and balances are needed.³²

All this changed in the seventeenth century. In part the motivation for this sea-change were the more or less scientific considerations discussed in Chapter 1, to which I will return in Chapters 6 and 7. The theological motivation for this shift cannot, however, be underestimated. The late sixteenth and early seventeenth centuries saw a renewed interest in Platonism. Given the prevailing Christianised Aristotelianism of the Schools, it was important that neo-Platonism was shown to be consistent, indeed more consistent than Aristotelianism, with the teachings of the Church. The denigration of the senses, and the possibility of explaining their weakness in terms of the Scriptures, lay at the heart of this project. This is especially clear in one of the most important pieces of seventeenth century philosophy, Malebranche’s *Search After Truth*. After four short introductory chapters – and before he proceeds to detail any specific errors associated with the misuse of the senses – Malebranche seeks to justify scepticism with regard to the senses on Biblical grounds. The “corruption of the senses”, he thinks, can be traced to no less an event than the Fall, when Adam:

voluntarily turned himself away from the presence of his God by allowing his mind’s capacity to be exhausted by the beauty and anticipated sweetness of the forbidden fruit, or perhaps by the rash joy excited in his soul by the contemplation of his natural perfections, or finally by his natural fondness for his wife and the inordinate fear of displeasing her.

³² See, for instance, *De Anima* 418a, 428b. For a general discussion, see Gaukroger 1990: 4-10.

Having tasted the forbidden fruit, Adam's senses and his passions "revolted against him...they enslaved him, as they do us, to sensible things". To remedy the predicament in which we find ourselves as a result of Adam's Original Sin, we therefore need to "struggle continually against our senses". About this, Malebranche thinks, "reason is in perfect agreement with the gospel".³³

This curious theological justification for rationalism underlines the point that it is not just obvious that we should take as our *starting point* the assumption that there is a case to be answered against the senses. That our colour perception is unreliable – that it does not veridically reveal the real colours of objects – is supposed to be the conclusion of the Argument from Perceptual Variation, not an assumption of it.

5. Spectral Inversion

Is the fact that normal trichromatic subjects accurately perceive the determinable colours of material objects anything more than a happy coincidence? We certainly seem able to imagine more or less far fetched situations in which colour perception goes awry as a result of changes in either our constitution or environment. Imagine, for instance, that the vitreous humour between the retina and the lens is replaced by a fluid that absorbs light from the yellow part of the visible spectrum, or a gas released into the atmosphere to similar effect. At the limit, imagine that genetic mutation or 'Z-rays' in the atmosphere brings about a complete and systematic permutation in colour appearance, making colours appear the exact opposite of the colours they currently appear.³⁴

If the relationship between colours and our colour experiences is ultimately contingent in this way, then this raises a serious problem. Colours are supposed to explain our colour experiences. They cannot explain our colour experiences, however, if the very same colour could have produced in us quite different colour experiences. Although the precise nature of the relationship is controversial, there is at least *some* connection between causation, causal explanation and counterfactuals. An object's being green cannot explain its appearing green if the very same object

³³ 1674-5: 23-4. It should, of course, be noted that it is not our senses, but the *improper use* of our freedom in making judgements on the basis of our senses that according to Malebranche is the cause of our error.

³⁴ These examples are from Averill 1992, Chalmers Forthcoming and Edwards 1997.

could have been a different colour and still appeared green: its being green would simply be irrelevant to the explanation of why it appears green.

For the purposes of this objection, it does not matter whether the systematic permutation of colours and our colour experiences is detectable. A systematic permutation of colour appearance is certainly much easier to imagine than a situation in which the sizes and shapes that objects visually appear to be are systematically misrepresentative of their real nature. If square towers systematically looked round, the permutation is one that we could soon detect: we would realise that something was wrong when we tried to walk around these towers, staying a constant distance from the walls without making any 90° turns; or, tracing our hands around the tower, we noticed four sharp, equally spaced, corners; or so on. Colours, in contrast, lack the wide cosmological role of shape and size: they are mind-independent properties of objects that cause our colour experiences, but not much else besides. It therefore does not take a great leap of imagination to conceive of situations in which the experiences that colours produce are systemically permuted. The impact of permutation of this kind on the rest of our lives would be at best minimal. So long as the permutation was stable, it would not greatly affect the primary uses to which we put colour vision: we could still use colour vision to segregate the visual scene, and identify and reidentify material subjects. As Malebranche remarks:

sensations of colour are given to us only for the purpose of picking out one body from another and it would do as well to see the grass as red or green as long as the person seeing it as red or green always saw it in the same way.³⁵

Of course, if we're supposing that the colour perception of one section of human society is permuted with respect to another, then the permutation may yet be detectable. The property space that human colours define is asymmetrical: it does not contain any axes of symmetry along which its elements can be inverted, such that this inversion would not be noticed. Consider, by way of illustration, the blue-yellow axis. Blues look blue at all lightness levels, whereas yellows only appear yellow at high levels of lightness: if a yellow sample is darkened, this induces a hue

³⁵ 1674-5: 66. Locke, in the quotation at the start of the chapter, agrees with Malebranche that a stable spectral inversion would not affect the uses that we make of colour perception, but disagrees with Malebranche that this kind of inversion is rife.

shift, and the sample ceases to look yellow and appears brown instead. Therefore if the colour perception of a community of otherwise normal human subjects was permuted along the blue-yellow axis, this permutation would be readily detectable. Watching the Oxford-Cambridge boat race, for instance, a member of the permuted community would judge that the two teams were wearing tops whose colours differed in kind, whereas we would say that their tops were both shades of the same colour: hence the names, Oxford *blue* and Cambridge *blue*.³⁶

Still, to get the explanatory problem going it is sufficient that an object could be really dark blue and yet appear brown. If blue things could be exactly as they are and yet look brown, then this threatens the availability of blueness in explanations of our blue experiences. The current discussion of colour permutation therefore differs from more standard discussions in which spectral inversion figures: in relation to behaviourist, functional, or physical theories of the mental, where the inversion has to be undetectable. If anything, however, this difference actually makes the current problem *more* intractable. If the inversion has to be undetectable for the argument in which it features to work, then this at least leaves open responses based on the asymmetrical – or more controversially, necessarily asymmetrical nature – of colour space. Although, for reasons that I come back to in §6.5, this kind of response may not be ultimately successful, at least it is not foreclosed at the very outset.

Can we resist the argument against the mind-independent reality of colours in some other way? The argument depends crucially upon the claim that it is *conceivable* that, contrary to empirical fact, colours and the colour experiences that they are properties to produce could be systematically permuted. This suggests two different strategies we could employ: deny either the conceivability claim or the inference from conceivability to possibility.

Questions about conceivability raise a number of thorny issues. But the prospects for the first strategy – denying the conceivability claim – do not seem especially promising. Something will have gone very badly wrong with our account of conception if it turns out that we cannot at least conceive of the systematic permutation of our colour experiences: if we cannot conceive of marigolds looking like violets, and *vice versa*.

³⁶ See Palmer 1999b for a discussion of asymmetries in colour space.

The second option – denying the inference from conceivability to possibility – is therefore much more promising. First of all, consider in more detail the scenarios in which permutation is supposed to occur. Although it is very easy to gesture at situations in which the systematic permutation of colour experiences could arise, more sober reflection on the details of these situations raises serious doubts about their cogency. Consider, for instance, Averill’s claim that, “the human eye could change, in certain physically possible ways, so that after the change a few objects would appear to be different in colour to normal observers”: for instance, that the vitreous humour in the eye could be replaced by a fluid that absorbs light in the yellow part of the visible spectrum.³⁷

Even if the kind of change in the eye that Averill describes were physically possible, the first thing to say is that it is not simply obvious that there would be a corresponding change in the colours objects appear. Consider, by way of comparison, actual physiological differences amongst normal human perceivers. According to the simplified opponent-process model used by Hardin, the signal in the yellow-blue opponent psychophysical channel is determined by summing the output of the **L** and **M** retinal receptors, and then subtracting the output of the **S** cones. Given this, it seems natural suppose that substantial differences in the ratios of **L** and **M** cones in the eye should dramatically alter individual subjects’ perception of yellow. In fact, however, the ratio of **L** to **M** cones in subjects who do not differ substantially in their location of unique yellow can range from anything between 10:1 to 0.4:1. Neitz *et al* explain this finding by suggesting that colour perception is mediated by a “plastic neural mechanism” that compensates for low-level differences in a subject’s perceptual apparatus.³⁸ But if in general there is this adaptive ability, perhaps a difference in the vitreous humour of the eye would not lead to a significant difference in colour appearance after all.

The fact that the visual system has this incredible adaptive ability in the first place raises a deeper point. There has to be some reason why the visual system goes to the trouble of normalising the output of its retinal receptors in this way. It must confer upon it some tangible advantage. Assuming that evolution represents an adaptation to features of the environment, a natural suggestion is that the advantage

³⁷ 1992: 552.

³⁸ Neitz *et al* 2002: 784. We have already encountered the functional plasticity of the neural mechanisms that realise colour vision in explaining differences in the spectral location of unique green (§5.3).

that this normalisation confers is that of enabling the visual system to veridically track mind-independent properties of material objects. Evolution may not be part of fundamental physics, but it is surely, in some suitably inclusive sense of the word, a 'physical theory'. But if so, then consistent with the evolutionary fitness of humans to track colours in their environment, perhaps it is not in fact *physically possible* for our eyes to undergo the changes that would result in a systematic permutation of colour experience after all.

These considerations raise difficult questions for the inference from conceivability to possibility on which the permutation argument rests. But they do not yet fully vindicate the naïve view that colours are mind-independent properties. The thought that colours could be systematically permuted is a very natural one: talking about colour to the folk, you invariably encounter some variation on 'I've often wondered whether what I see as green is the same as what everyone sees as green'. This very common intuition does not rely on any complicated thoughts about genetic mutation or changes in the vitreous humour. It relies just on the simple idea that you can imagine marigolds appearing the colour that violets currently appear, and *vice versa*. Given that the motivation for defending the mind-independence of colour was in the first place to respect our naïve thought about colour, it therefore seems somewhat duplicitous at this point to dismiss in so perfunctory a way the common sense intuition that my colour experiences might have been different.

The problem is not so much that spectral inversion is inconsistent with the naïve view that colours are mind-independent properties: it seems unreasonable to demand of any theory that it at no point come into conflict with common sense. It is rather that nothing has been done to mitigate the intuitive pull of the objection against the mind-independent reality of colours. A satisfactory response to the objection needs to *explain away* the conceivability. It needs to explain why, even though it is clearly conceivable that our colour experiences could be systematically permuted, the inference from conceivability to possibility fails.

To this end, we need to consider in more detail why the problem arises in the first place. The permutation problem gets a grip because in trying to accurately capture the phenomenology of experience we drive a wedge between colours and our colour experiences. To say that colours are mind-independent is just to say that

we can make sense of these properties existing in the absence of our experience of them. I have argued that we are able to conceive of the unperceived existence of colour in virtue of thinking about the internal relations of similarity and difference in which colours stand. The permutation objection now works by severing the tie between these two different aspects of our conception of colour: by holding fixed our grasp of the ‘internal relations’ in which colours stand and varying the ‘external relations’ the objects that instantiate them bear to perceiving subjects. In other words, the permutation problem exploits our *bipartite conception of colour*. That we can conceive of colours producing different experiences to the experiences they actually produce reflects the fact that we have the conceptual resources to think about colours and the colour experiences that they produce in relative independence of each other. Indeed, the fact that the permutation objection *is* such an intuitive objection supports the original claim that we conceive of colours as mind-independent properties: the objection would not be so intuitive if we did not, at least implicitly, think of colours in this way.

The important point to stress here, however, is that it does not follow from the relative *conceptual* independence of the internal and external aspects of colour that there is a corresponding *metaphysical* distinction. Perhaps, to use Cartesian terminology, the distinction between the internal and external aspects of colour is not a *real distinction*: it is not a distinction between entities that are actually, or even counterfactually, capable of independent existence. The distinction may just be a mere *distinction of reason*. The internal and external aspects of colour may be distinct only in the sense that we can think about them in relative conceptual independence.³⁹

Using this distinction between distinctions, we can explain why it is that we can conceive of spectral inversion and at the same time deny its possibility. In effect, the mistake the permutation objection makes is akin to that which Descartes accuses the Scholastics of making in treating colours as ‘real qualities’ (§1.1): we confuse conceptual with metaphysical independence. In conceiving of a situation in which yellowness has the power to produce blue experiences, for instance, we rightly

³⁹ On the difference between real distinctions and mere distinctions of reason, see 1644: I.51-61, and 1641, *First Replies*: 85. Descartes actually uses the term ‘distinction of reason’ to refer to the distinctions between substances and properties and different properties of the same substance, not aspects of the same property. Hopefully, though, the extension of this term to the latter case is clear enough.

appreciate the conceptual independence of the internal and external aspects of yellowness, but illicitly draw from this the metaphysical conclusion that yellowness *could* produce in us blue experiences, and therefore that it is merely a contingent fact about yellowness that it produces blue experiences. But the conceivability of systematic permutation does not entail its possibility. The distinction between colours and their powers to produce experiences may be nothing more than a mere distinction of reason.

[6] Physicalism

Why *Yellow* holds a sympathy, or symbolical relation with *Vermillion* and *Green*, and *Green* with *Sky-colour* and *Yellow*...is no other but the *Affinity of their respective Causes*.

Charleton 1654: 192.

PHILONOUS. ...are you sure then that sound is really nothing but motion?

HYLAS. I am.

PHILONOUS. Whatever therefore agrees to real sound, may with truth be attributed to motion.

HYLAS. It may.

PHILONOUS. It is then good sense to speak of *motion*, as of a thing that is *loud, sweet, acute, or grave*.

Berkeley 1713: 172.

The mind-independence of colour is consistent with different accounts of what colours are. According to *physicalists*, colours are properties that have a hidden essence only revealed by physical theory: typically, they are surface reflectance properties in virtue of which material objects modify incident light.¹ Although this kind of physicalism about colour is consistent with the common sense view that colours are mind-independent properties, it does not fully vindicate the deliverances of our ordinary colour experience, as colours turn out to be properties whose essential nature is hidden from view. Physicalism about colour contrasts in this respect with the view that colours are *sui generis* mind-independent properties: mind-independent properties that are distinct from the light affecting properties described in physical theory. If colours are *sui generis* properties, then colour experience is itself sufficient for us to know what these properties are.

Whether colours are physical properties is the subject of this chapter. In §6.1, I argue that there is no short cut to the conclusion that colours are *sui generis* mind-independent properties via *Revelation*, the thesis that colours are properties whose entire nature is revealed in visual experience. Although I will eventually argue that revelation is (at least in some sense) true, its truth is not enshrined in common sense thought about colour; indeed, it follows from the naïve view of colours as mind-independent that whether colours transcend our experience of them is an open question. Whether colours are physical properties depends instead on whether there

¹ This is so far a stipulative definition of *physicalism*, albeit one that coheres with the way in which this term is generally used. I discuss what is meant by 'physical' in more detail in Chapter 7. In advance, however, it should be noted that the denial of physicalism should not simply be equated with the denial of naturalism, broadly construed.

are any physical properties that can explain distinctive features of the phenomenology of our colour experience. Although common sense does not require that colours have *only* those properties that they appear to, it does at least assume that they have *all* the properties that we perceive them to.

The general problems for physicalism in this respect are illustrated in §6.2 by considering Newtonian theories of colour, whilst §6.3 considers more recent attempts to identify colours with light-affecting properties. In each case these theories fail to respect the naïve intuition that colour experiences simply *inherit* their phenomenology from the properties that they are experiences of. Particularly problematic is the identification of physical properties that stand in the internal relations of similarity and difference characteristic of the colours. Consistent with there being no physical properties that stand in these relations, two attempts to deny that colours are perceived to stand in any relations of similarity and difference at all are considered in §6.4, whilst §6.5, in contrast, considers an attempt to employ the selection metaphor encountered in §4.4 to identify physical properties that stand in the right internal relations after all. Ultimately, however, I will suggest that we can only accept the phenomenological inheritance thesis if colours are *sui generis* properties.

1. Revelation

To decide whether our ordinary conception of colour is consistent with physicalism, we first need to determine quite how much is implicit in our common sense thought about colour. It is, for instance, sometimes suggested that we ordinarily conceive of colours as properties whose entire (or intrinsic) nature is *revealed* – or, substituting one metaphor for another, *laid bare* – in visual experience. In his influential discussion of this question Johnston, for instance, claims that *Revelation* – which Johnston states as the thesis that “the intrinsic nature of [for example] canary yellow is fully revealed by a standard visual experience as of a canary yellow thing” – is one of five core common sense beliefs about colour. In other words, according to

Johnston it is part of our ordinary thought that colours have not just all, but *only* those properties that they appear to have in visual experience.²

If this is right, then it represents a short cut to the conclusion that physicalism is inconsistent with the truth of our ordinary colour thought. According to the physicalist, colours are properties whose nature outruns the conception of them that we are able to form on the basis of visual experience: they are properties that have a hidden essence it is the role of physical science to uncover. If it is part of our naïve thought about colour that colours are properties whose entire nature is simply laid bare in visual experience, then physicalism necessarily convicts ordinary thought of error from the very outset.

But as a descriptive metaphysical claim – a claim about the actual structure of our conceptual scheme – is this correct? Leaving to one side the question of whether Revelation is actually true, do we at least ordinarily *take* colours to be properties whose entire nature is revealed in visual experience?

Answering this question is not a straightforward matter, as it is not immediately clear even what it means to say that colours appear to be properties whose entire nature is revealed in visual experience. In no small measure, the problem lies in the unclarity of the key terms: ‘entire’ or ‘intrinsic’, and ‘visual experience’. Johnston is himself acutely aware of this problem, and at this point defers to the great and the good for assistance. If anything, however, the great and the good to whom Johnston appeals actually undermine his claim that Revelation is part of our common sense thought about colour. Consider, for example, the following remarks from Russell:

the particular shade of colour that I am seeing...may have many things to say about it...[but] so far as concerns knowledge of the colour itself, as opposed to knowledge of truths about it, I know the colour perfectly and completely when I see it and no further knowledge of it is even theoretically possible.³

Johnston uses this passage to try to explain the thesis of Revelation that he attributes to common sense. The first thing to say about this remark, however, is that it is not even clear that the contrast that Russell has in mind is the contrast in which Johnston is interested. Russell makes this remark in the course of

² Johnston 1992: 1389. For discussions of Revelation that follow Johnston, see McLaughlin 2003: 97-8 and Byrne and Hilbert Forthcoming.

³ 1912: 25.

distinguishing between *knowledge by acquaintance*, which is grounded in ‘direct awareness’ of a thing, and *knowledge by description*, which is grounded in intermediary processes of inference. The distinction that Russell is trying to track is therefore the distinction between things of which we are directly aware and things to which we have only intermediate access. But of itself, the mediate-immediate distinction is not even co-extensive with the distinction between things whose nature we know entirely and things whose nature our experience leaves in any way indeterminate. We can, so the joke goes, be indirectly aware of an elephant in the fridge by seeing footprints in the butter. But this does not mean that by (immediately) seeing the footprints in the butter we thereby come to know what butter *is* ‘perfectly and completely’. Visual experience does not, for instance, suffice to tell us anything about the chemical composition, or even the taste, of butter.

Part of the problem here is that Russell’s contrast between knowledge of ‘colour itself’ and ‘truths about colour’ is itself left somewhat vague. Insofar as the surrounding context helps to determine this unclarity, however, it does so by underlining Russell’s distance from common sense thought at this point. Russell’s remark is made within the context of arguing for a theory of perception according to which the immediate objects of perception are not persisting mind-independent material objects and their abiding properties, but *fleeting mind-dependent sense-data*. The mind-dependence of sense-data offers a clear rationale for the view that colours are properties whose entire nature is laid bare in visual experience. If sense-data and their properties depend for their existence on our experience of them, then it is a natural thought that their nature cannot transcend this experience; there *can* be nothing more to these experience-dependent properties than those features of which we are aware. But equally clearly – at least unless we are Berkeley – a sense-datum theory of perception is no part of our common sense thought, and Russell himself does not himself claim otherwise: that mind-independent objects and their properties are the objects of perception is one of the things that Russell thinks we assume to be certain in daily life but which, “on a closer inspection, is found to be so full of apparent contradictions that only a great amount of thought enables us to know what it is that we really may believe”.⁴

⁴ 1912: 1. In trying to elucidate Revelation, Johnston also refers to Galen Strawson’s remark that “colour words are words for properties which are of such a kind that their whole and essential nature as

At this point, things get even worse for Johnston. Not only does Russell not attribute Revelation to our ordinary thought, but if Russell does think that anything like this thesis is in fact true it is not because he thinks that there is anything special about colour *per se*. It is because he holds the more general view that the objects of experience depend for their existence on our perception of them. For Russell, Revelation is as true of primary qualities like shape and hardness as it is of secondary qualities like colour, as the sentences immediately preceding that quoted above make clear:

We shall say that we have *acquaintance* with anything of which we are directly aware, without the intermediary of any process of inference or any knowledge of truths. Thus in the presence of my table I am acquainted with the sense-data that make up the appearance of my table – its colour, shape, hardness, smoothness, etc.; all these are things of which I am immediately conscious when I am seeing and touching my table...

At this stage, Russell still thought that we could infer the nature of persisting mind-independent material substance from the mind-dependent direct objects of experience. As Russell himself later came to realise, there are, of course, serious problems with this view: the mind-independent world becomes at best a noumenal ‘something-we-know-not-what’, the unknowable causes of our experience. The possibility of determinate thought about a mind-independent world therefore involves denying precisely this kind of view of our primary quality concepts. We cannot simply be thought to have a “purely sensory conception” of an object’s primary qualities. Possessing a conception of a mind-independent world requires richer concept forming mechanisms than empiricists like Berkeley and Russell allow for. As Evans, for instance, puts it:

it does not appear to be possible to regard the conception of the shape of a material thing – with all the propositions about its characteristic behaviour and interaction with other bodies that this implies – as the same as whatever shape concepts might be grounded in the colour mosaic thought to be given in immediate visual experience.⁵

We need to suppose instead that the sense of our shape concepts is determined in part by the primitive theory that we bring *to* sensory experience. In other words we

properties can be and is fully revealed in sensory-quality experience given only the qualitative character that that experience has”, 1989: 224. These remarks are made within the context of arguing that the immediate objects of colour perception are mind-dependent sensational properties of a pixelated visual field.

⁵ 1980: 270.

need to suppose that Revelation, as it is stated by Russell, is false of the primary qualities.

The moral of the earlier discussion of Evans, however, was that if Revelation is false of the primary qualities, then it is also false of the secondary qualities. With respect to secondary qualities like colour, Evans accepts that Revelation as it is formulated in the Berkeley-Russell tradition is implicit in our ordinary thought. Evans's mistake, however, is to assume that the concept forming mechanisms licensed by empiricists like Berkeley are sufficient even to account for our secondary quality concepts. The sense of our secondary quality concepts, no less than the sense of our primary quality concepts, is determined at least in part by a primitive theory that we bring *to* sensory experience. It is only if we reject the poverty of the secondary quality concept forming mechanisms admitted by empiricists that we can respect our common sense belief in the mind-independence of colour, and acknowledge the role that this belief plays in grounding our conception of mind-independent material substance (see §2.3).

Once we accept this sufficiently rich understanding of 'visual experience', it becomes increasingly difficult to attribute to ordinary thought the view that the entire nature of colour is revealed in ordinary visual experience. If colours are, as they appear to be, mind-independent properties, then there is no obvious reason why their nature could not outrun our conception of them. To say that colours are mind-independent is just to deny that their existence depends on our experience of them. And if colours do not depend for their existence on our experience of them, then there is no obvious reason to suppose that there couldn't be aspects of their nature about which we are ignorant. Indeed, to at least some extent, this is precisely what we find.

Despite lacking an especially wide cosmological role, colours are still capable of conferring surprising causal powers on their bearers. Nor do we think that there is anything absurd in this, as we should if it was part of our ordinary thought about colour that the *entire nature* of colour is simply revealed in visual experience. The relationship between colour and light, for instance, is not simply laid bare in experience. In the post-classical West, it was not until the resurgence of mechanism in the seventeenth century that the idea of a close link between colour and light really gained currency at all: up until this point the predominant view was still the

Aristotelian view that colours literally separate themselves from material objects, fly through the air and imprint themselves on the sensory organs.

The more specific relationship between colour and light was not known until much later still. It is only by experimenting with differently coloured lights that we discover relatively robust correlations between colours and their propensity to reflect these lights. White objects, for instance, reflect equally and in good measure light of any colour, thereby taking on the appearance of the light under which they are illuminated. Black objects also reflect light of any colour equally, but do so in each case poorly, and so take on the colour appearance of no light. Chromatically coloured objects, in contrast, reflect to a greater or lesser extent light of any colour, although generally fail to reflect in any substantial way light of their *complement*. Complementary colours are the colours of coloured lights that yield an achromatic colour when the two are additively mixed: red, for instance, is the additive complement of green and *vice versa*, yellow the additive complement of blue and *vice versa*, and so on.⁶

This is not the only surprising effect that objects can have in virtue of being coloured. The effect on perceived colour of simultaneous contrast can also be unexpected. Chevreul's weavers, for instance, were certainly surprised to be told that it was the juxtaposition of black with red on their calicos that caused the black to appear slightly greenish, and not the inferior quality of the dyes used in the Gobelin tapestry factory. Indeed, we are liable to find even very simple simultaneous contrast effects, like Figure 3.1, shocking when we first see them.

No less surprising can be the higher-level effects of colour on our mood and aesthetic sensibility. For instance, it is only once you realise that red makes people eat faster that you understand the rationale behind the colour schemes in fast food restaurants. The aesthetic effects of different colours are similarly something that we need to discover through experience: colours that in the abstract sound as though they will be terrible in combination can be surprisingly effective, and *vice versa*.

What about the other aspect of colour: the internal relations of similarity and difference in which colour stand? Given the role that I have argued grasping these relations plays in our conception of colours as mind-independent properties,

⁶ These facts form the basis of Westphal's general account of colour. Westphal identifies colours in terms of the coloured light that objects fail substantially to reflect. Westphal 1987: especially 80-6. For discussion, see Broackes 1992: 211-18.

ordinary visual experience must in general be sufficient to ground knowledge of these relations. By and large, this is clearly correct. We do not, for instance, need to go to great lengths to discover that yellow is more like orange than red, or that blue is more like cyan than green. These facts are just obvious: they simply force themselves upon us in the relevant circumstances. But is the *entire* nature of this aspect of colour known in this way?

Brown is at least potentially problematic. With no direction, it is not unnatural to class brown amongst the elemental colours: red, yellow, green, blue, black and white. Whereas dark blue clearly appears to be a perceptual mixture of blue and black and pink a perceptual mixture of red and white, brown can seem much more difficult to place. Fuld *et al*, for instance, found that given free use of ordinary colour vocabulary most subjects require ‘brown’ in addition to ‘yellow’ and ‘black’ to describe samples from this region of colour space. Subsequent experiments by have cast doubt on whether brown really is an elemental colour: when directed to name colour samples using just the names of the standard six elemental colours, Quinn *et al* found that subjects do not hesitate to describe brown samples in terms of yellow and black – indeed, once you hear this, it can be difficult *not* to see the previously obscure affinity between brown, yellow and black. But still, this at least suggests that there can be non-obvious facts about colour space.⁷

Similarly surprising can be the discovery of internal relations of similarity between the elemental colours themselves. When the differences between samples are too great, direct judgements of similarity tend to collapse. This can make it difficult to determine directly similarities between the elemental colours.⁸ As a rough illustration, line up – with the spine facing towards you and in this order – the green Selby-Bigge/Nidditch edition of Hume’s *Enquiries*, the blue Ayers edition of Berkeley’s *Philosophical Works* and the red Kemp Smith’s edition of Kant’s *Critique*. Are any two of these more similar to each other in respect of colour than either is to the other? This question may seem difficult to answer with any great certainty; certainly much more difficult than if you replace the Berkeley with the green Lennon-Olscamp edition of Malebranche’s *Search After Truth*. Yet we know from empirical investigation into human colour space that Berkeley and Hume actually

⁷ Fuld *et al* 1983, Quinn *et al* 1988.

⁸ Indow 1988: 461.

more closely resemble each other than either resemble Kant (maybe you can judge some books by their covers after all!).

Human colour space is asymmetrical: it is not possible to map just any point of this space onto any other whilst at the same time preserving the structure of the space. This manifests itself in a number of ways, although for present purposes just consider the dimension hue. According to the Munsell system of colour classification, which divides the hue circle up into 100 perceptually equal steps judged at the level of just noticeable differences, there are not four, but *five* basic hue groups: the four elemental hues identified by Hering – red, yellow, green and blue – plus purple. The reason for this is that the number of perceptually equal hue steps between the unique hues in the Munsell system varies considerably: from red to yellow it is 23; from yellow to green, 18; from green to blue 28; and from blue to red 31. Purple is identified as a basic Munsell hue so that the basic hues can be equally spaced around the perimeter of the hue circle.⁹

It is important to exercise caution when approaching the Munsell data, as the samples in the Munsell colour atlas are spaced according to colorimetric rules of additive colour mixture using photometers and Maxwell disks, rather than direct visual observation. As a result, multi-dimensional scaling (MDS) studies on the Munsell system of colour classification have since revealed slight anomalies: along the hue axis, for instance, in the blue-purple region, unnoticed during the Munsell renotation of 1943, whereby colours between Munsell-Blue ('5B') and Munsell-Purple-Blue ('5PB') look comparatively too similar to each other.¹⁰ Still, these MDS studies vindicate Munsell's basic partition of the hue circle into five, a feature preserved in the isotropic Optical Society of America (OSA) colour space, which unlike the Munsell system does give a strict preference to colour appearances over psychophysical data.¹¹

This means that we need to add to the most commonly cited similarity and difference relations, similarity and difference relations *between the elemental colours themselves*: according to the recalibration of the Munsell system suggested by MDS

⁹ Although this requires slightly adjusting the locations of the other unique hues: although Munsell-Green, Yellow and Red correspond quite closely to unique green, yellow and red, Munsell-Blue is quite a long way from unique blue, and looks like a blue-green. See Sivik 1997: 170.

¹⁰ There are also slight anomalies along the axis of saturation ("Chroma"): the first step tends to be much larger than any of the others whilst, conversely, the last steps tend to be much smaller than the rest. See Indow 1988.

¹¹ Indow 1988: 463, Jameson and d'Andrade 1997: 299-301.

studies, for instance that blue and green are more similar to each other than either is to the adjacent elemental hue. This certainly explains some striking linguistic phenomena. If blue and green are more similar to each other than either is to the adjacent hue, then it makes perfect sense, for instance, that most languages contain the so-called “composite basic colour terms” ‘warm’ and ‘cool’, the former referring to red and yellow, and the latter to blue and green.¹² Indeed, this also explains the fact that in some languages green and blue can even be used interchangeably: in Japanese, for example, it is at least rhetorically acceptable to use the phrase “blue leaves”.¹³

What these examples show is that we can be surprised both by the causal powers associated with colours and the internal relations of similarity and difference in which colours stand. Now of course, as it happens, these are all cases in which colour experience is itself necessary to discover the initially recalcitrant phenomena. It is, for instance, by using our colour vision to arrange coloured chips into a similarity ordering that we realise that blue and green are in fact closer to each other than either is to the nearest elemental colour. Similarly, it is by perceiving the effects of shining coloured lights at objects that we discover that, for example, white objects take on the appearance of the incident light, and so on. But there is no obvious reason why all novel facts about colour *must* be discoverable in this way. If colours are, as common-sense dictates, mind-independent properties, then it seems reasonable to suppose that colours might turn to have causal powers of some wholly different kind; causal powers that impact in no way upon conscious experience. If so, then there is no way of ruling out in advance the possibility that colours are identical with physical light-affecting properties of objects.

2. Wavelength-Physicalism

It follows from the common sense view that colours are mind-independent properties that there is no reason to suppose that they must instantiate *only* those properties that visual experience can discover. Far less negotiable, however, is the thought that colours at least have *all* the properties that we can perceive them to.

¹² Berlin and Kay 1969.

¹³ Indow 1988: 464.

Common sense dictates that experience is generally the way that it is because of facts about the world: things appear thus-and-so is because things *are* thus-and-so. In the case of colour, this means that it is natural to suppose that the character of, for example, a yellow experience is explained by the way yellowness actually *is*; it is explained by the qualitative character of what that experience is an experience of, yellowness itself. As Campbell puts it, the natural thought is that colour experiences *inherit* their qualitative character from the colours they are experiences of.¹⁴ In effect, this just falls out of the *simple theory of perception* that we need to grasp in order to conceive of mind-independent existence in the first place. To grasp a simple theory of perception is to grasp the distinction between our experiences and that of which our experiences are experiences, and thereby grasp the thought that our experience is responsive to features of the world (§2.1).

To decide whether colours are physical properties we therefore need to determine whether there are any physical properties that are consistent with this *Phenomenological Inheritance Thesis*. If there are not, then physicalism will be incompatible with our common sense thought about colour. Of itself, this will not show that colours are *sui generis* properties. Still, in advance of addressing the problem of locating *sui generis* mind-independent colours within the natural world, this will at least give us a defeasible reason for thinking that colours are not physical properties.

How well, then, does physicalism fare at respecting the Inheritance Thesis? The range of material world entities perceived to instantiate colour is spectacularly diverse. It includes lights, liquids, gases, and all kinds of solid material object, from transparent stained glass to opaque coffee tables and mugs. Amongst coloured things there are at least fifteen standard causes of colour experience, from incandescence, molecular vibration and excitation, transitions between molecular orbitals, to dispersive refraction, diffraction and scattering.¹⁵ Given this diversity, the prospects for identifying a non-disjunctive microphysical property shared by things that are all perceived to instantiate a common colour, let alone explaining the perceived internal relations between the colours in terms of these heterogeneous properties, are not especially promising.

¹⁴ Campbell 1993: 189. For a discussion of the ‘inheritance’ metaphor, see Shoemaker 2003.

¹⁵ For more details, see Nassau 1983.

Much more promising are the properties of objects to modify light: by reflecting, refracting, diffusing, scattering or emitting this light in a specific way. This is a point that has long been appreciated. The Cartesians, for instance, identified colours with dispositions of objects to affect the rotational motion of light particles (“globules of the second element”). On the Cartesian view, white bodies reflect light without affecting its nature, black bodies entirely “break up the light-rays that meet them and take away all their force”, whilst chromatically coloured objects affect the light particles in way analogous to the way in which ‘grazing’ a ball affects its motion. As Descartes explains in the *Description of the Human Body*, for instance, if the speed at which particles of light rotate is smaller than that of their rectilinear motion (their local motion towards the eye), then the body appears blue; if, on the other hand, the rotational speed of the light particles that a body reflects is greater than their rectilinear motion, then the body appears red.¹⁶

A significant failing of the Cartesian account of colour, however, is the imperspicuous nature of the relationship between the disposition of objects to affect the rotational motions of light particles and the colour that these objects are thereby perceived to be. In the case of the achromatic colours, there is at least a fairly intuitive connection between light interaction and perceived colour: the less the body affects the motion of the light particles, the more intense the motions of the corpuscles that a body is disposed to reflect, and hence the more intense the sensation of white; in contrast, the more the body ‘takes away’ the motion of the particles, the less intense their force, and hence the less intense (i.e. the greyer) the sensation.¹⁷ When it comes to the chromatic colours, however, the relationship between the way in which a body affects the light and the colour it is perceived to be is wholly opaque. Why *should* objects that reflect light particles whose rotational motion is greater than their rectilinear motion look precisely red? And how is this model supposed to generalise to the other chromatic colours in such a way as to explain the internal relations in which these colours are perceived to stand? Even the usually optimistic Descartes held out little hope of discovering an intuitive relationship between perceived colour and dispositions to affect light, suggesting

¹⁶ c1648: 323; cf 1637: I, CSM i: 156.

¹⁷ Even Malebranche, who thought that would only be “through the most remarkable luck in the world” that everyone had the colour sensations when perceiving the same objects at least thought it “never, or almost never, happens that people see black or white other than as we see them”, 1674-5: 63-6.

that the relationship could only be determined experimentally, and not *a priori*.¹⁸ To say that the relationship between physical properties and colours is wholly imperspicuous, however, is just to give up on the Inheritance Thesis, the common sense thesis that experiences simply inherit their qualitative character from the properties that they are experiences of.

Newton's detailed investigations into the heterogeneous nature of daylight, as composed of "*rays differently refrangible*", seemed to at least offer a promising solution to this problem.¹⁹ According to the Newtonian picture, different colours are associated with each of the different rays that compose daylight. Taking these 'colours' of the ('pure') monochromatic spectral lights as basic and generalising, Newton was able to forge at least some connection between the colours objects appear and the colour of the light that they reflect, suggesting that:

Every Body reflects the Rays of its own Colour more copiously than the rest, and from their excess and predominance in the reflected Light has its Colour.²⁰

So, for instance, yellow objects are yellow because, it is said, they reflect light predominantly from the 'yellow' part of the visible spectrum, circa 575nms, green objects are green because they reflect light from the 'green' part of the spectrum, circa 550nms, and so on.

The Newtonian 'wavelength' conception of colour dominated the scientific landscape well into the twentieth century, and is still the view of colour ingrained in scientifically tutored common sense to this day. Even leaving to one side its empirical inadequacies, however, the problem with the Newtonian conception of colour is that it too fails to respect the Inheritance Thesis.

In the first place, the Newtonian view tries to explain all colour appearance by generalising from monochromatic spectral lights that stand in a 1-1 relation with perceived colour. But the spectral colours are only a subset of the colours that we can actually perceive. The generalisation from monochromatic spectral lights to

¹⁸ 1637: I, CSM i: 156.

¹⁹ Note, Newton did not *discover* the heterogeneous nature of daylight. Rainbows had long been known of, and at least since the thirteenth century man-made spectra – produced using globes of water and later, prisms – had been used in attempting to offer explanations of rainbows. Indeed, Descartes proposed an account of the production of rainbows in Discourse 8 of the *Meteorology* (1637), illustrating his account by reference to the divergent paths of rays from the sun when passed through a glass prism. For a brief overview, see Henderson 1970: 4-8.

²⁰ Newton 1730: 1.2.2, Def.

colour is therefore just not general enough: it does not explain the colour appearance of objects that appear different in colour to monochromatic spectral lights. This problem arises in relation to hue, saturation *and* lightness.

Of all external stimuli, monochromatic spectral lights are perceived at the highest level of saturation. Polychromatic ('mixed') lights and surface colours are always perceived to be less saturated: in the latter case, for instance, because some of the incident light that strikes them is always absorbed. Right from the outset, therefore, the most that can be hoped for from the simple wavelength conception of colour is an account of perceived colour in terms of hue matching which overlooks variations in saturation.²¹

The Newtonian account of colour is similarly insensitive to variations in lightness. Objects that appear to be lightened or darkened hues, for instance, fall outside of the scope of the Newtonian account. There are no spectral pinks (a perceptual mixture of red and white) and no light blues (a perceptual mixture of blue and white). Indeed, not only are there no *spectral* browns (yellow-orange plus black), but there are no brown *lights* at all. Brown lights are impossible. To be perceived, a light must be brighter than its environment: consider, for instance, trying to see whether an electrical appliance's red standby light is on when the appliance is bathed in sunlight, and you have to shield the light from the ambient illumination with your hand. Browns, however, can only be perceived if they are dark relative to their surroundings. Brown is 'pure contrast colour' that in the absence of the relative contrast cannot be perceived: so, for instance, if you view a chocolate bar through a reduction screen (or velvet lined tube) thereby eliminating the contrast effects, the chocolate bar does not appear brown, but orange-yellow. But a light cannot both be lighter than and darker than its background. Against the darker background necessary to perceive a light, a brown light therefore appears yellow-orange.²²

Accommodating the pure achromatic colours – colours that vary *only* in lightness – is no less problematic. According to Newtonian lore, white is the simultaneous presence of all colour, and black the complete absence of all colour:

²¹ Additive colour mixture creates a saturation mismatch, as monochromatic light always appears more saturated than polychromatic light. To further match the perceived saturation of two colour samples, it is necessary to mix a third light with the original source light, and thereby decrease its saturation. For example, mixing a specific proportion of green and blue light provides a *hue* match for a spectral light of 485 nms; for an exact *colour* match, however, a red light also has to be mixed with the original spectral light in order to reduce its saturation. Hurvich 1981: 99-112.

²² For a discussion of brown, see Westphal 1987: 40-56.

white light is composed of light of ‘all’ colours (more accurately all spectral colours) whereas black is the complete absence of all coloured light. Even ignoring the fact that it is actually sufficient to produce a white light that we mix just three (appropriately chosen) spectral lights, and not *all* spectral lights, however, there are serious problems with this account. Black and white come in degrees: black objects can be blacker than others, and white objects whiter than others. Can presence and absence of colour also come in degrees? And how does grey fit into this account? Grey appears to be a perceptual mixture of white and black. Is grey therefore the simultaneous presence *and* absence of all colour?

Indeed, the Newtonian account of colour is not even able to fully account for hue. Unique red is the reddest red: it is a red which appears to be neither greenish nor yellowish. Yet unique red is not a spectral colour. Neither are many of the colours that lie in the purple region of the hue circle. On the Newtonian account we therefore we cannot even explain why prototypically red things appear red, or purple things appear purple: there is no unique red spectral light for unique red things to be disposed to most copiously reflect, and no purple spectral light for purple things to reflect most copiously either.

Even if it were possible to explain all the colours objects appear in terms of the limited subset of spectral colours, however, the Newtonian account of colour would still fail to respect the Inheritance Thesis. First, and overlooking the fact that unique red is not even a spectral colour, the Newtonian account of colour cannot accommodate the special landmark status that we accord to the unique hues. There is no distinction corresponding to the unique-binary distinction at the level of wavelengths. Indeed, the very idea that uniqueness is able to mark *any* distinction amongst monochromatic light wavelengths is strained to say the least. By definition, all *monochromatic* lights are unique.²³

More importantly – given the fundamental role that I have argued these relations play in our thought about colour – the identification of monochromatic lights with perceived colour does nothing to explain the internal relations of similarity and difference in which colours stand. Monochromatic wavelengths only poorly approximate to perceived colour throughout the visible spectrum. Generally speaking, equal differences in wavelength do not correspond directly to perceptually

²³ Westphal 1987: 72.

equal differences in colour. We have already seen that in the green part of the visible spectrum, for example, hue changes slowly in comparison to wavelength: in the ‘green’ part of the visible spectrum (494-557nms) there is an average of 9nms for each perceptually equally spaced Munsell chip, whereas in the ‘yellow’ part of the visible spectrum (572-586nms) the average is just 2.8nms (§5.3). A similar phenomenon occurs at either end of the visible spectrum.²⁴ Indeed, a purple-blue light of circa 400nms and a deep-red light of circa 700nms are, in terms of their wavelength, as different as any two lights from the visible spectrum can be. Phenomenologically speaking, however, they are in fact very similar, as represented by their location on the hue circle.

Worse still, there is not anyway anything about light-reflecting objects that according to the Newtonian account can explain why they reflect precisely the coloured light they do. Why, for instance, yellow objects reflect yellow light most copiously is simply left as a brute fact: no further explanation, in terms of properties of yellow objects, is offered. Indeed, once we take into account Newton’s qualification that properly speaking even “the Rays...are not coloured”, any pretence at respecting the Inheritance Thesis dissipates entirely. According to the official Newtonian view, there are objects that, for some arbitrary reason, most copiously reflect light of a certain wavelength which, for some arbitrary reason, produces colour sensations in the sensorium. Outside of the sensorium, nothing is *really* coloured at all. Colour is, as Eddington put it, “a mere mind-spinning”.²⁵

3. Reflectance-Physicalism

At this point the physicalist has a get out jail free card. Wavelength-physicalism is not just conceptually flawed, but empirically flawed as well. Perceived colour is not correlated with the reflection or emission of light in the way that the wavelength conception of light predicts.

It is incorrect for polychromatic lights because the perceived hue of any given monochromatic light can be hue-matched by an indefinite number of

²⁴ Helmholtz 1911: 126-7.

²⁵ Eddington 1929: 94. In Newton’s words: “Colours in the Object are nothing but a Disposition to reflect this or that sort of Light more copiously than the rest; in the Rays they are nothing more but their Dispositions to propagate this or that Motion into the Sensorium, and in the Sensorium they are Sensations of those Motions under the Forms of Colours”, 1730: 1.2.2, Def.

polychromatic lights composed of monochromatic lights from radically different parts of the visible spectrum: a monochromatic ‘yellow’ light of 580nms, for example, can be matched by mixing a ‘chartreuse’ light of 570nms with a ‘yellow-orange’ light of 590nms, a ‘green’ light of 550nms with an ‘orange’ light of 610nms, and so on. What matters is merely that the light entering the eye is of the right overall composition.²⁶

The same true of surface colours. Most material objects reflect light at all spectral wavelengths. Whilst achromatic objects tend to reflect roughly the same amount of light at each spectral wavelength, chromatic objects reflect differing amounts of light across the visible spectrum. In each case, however, as with polychromatic lights, it is only the *overall* composition of the light entering the eye that is important. So, for instance, although chromatic bodies often do reflect more light from their ‘own part’ of the visible spectrum than from any other, it is not necessary that this is the case. Objects can reflect light most copiously from other parts of the visible spectrum. Consider, for instance, the surface reflectance profile of the yellow lemon represented in Figure 6.1. The two regions of the visible spectrum in which the lemon reflects the highest proportion of the incident light are around 640nms (roughly 67%) and from 690-700nms (roughly 74%). Neither of these parts of the spectrum is the ‘yellow’ part: 640nms is a fairly typical red, and 690-700 is a very dark crimson-red. In fact, in the ‘yellow’ part of the spectrum (roughly 580nms), the lemon only reflects about 63% of the incident light.

²⁶ Hurvich 1981: 89-98.

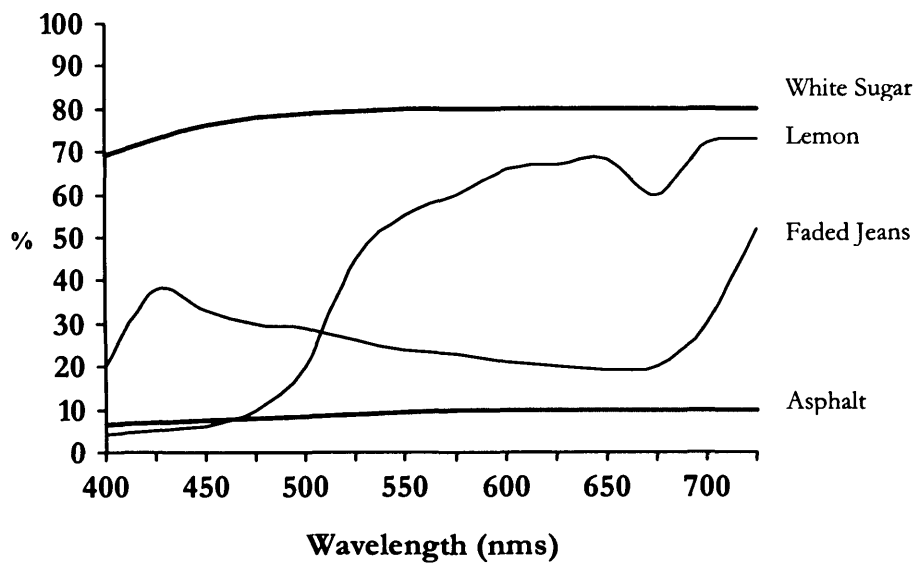


Figure 6.1: Sample Surface Reflectance Profiles
Source: Byrne and Hilbert 2003.

The obvious physicalist response in light of these empirical facts would be to identify colours, not simply with the properties of objects to reflect light most copiously from a certain part of the visible spectrum, but to identify colours instead with the properties of objects to reflect different proportions of light at *every* spectral wavelength: in other words, to identify colours with their overall reflectance property. But this can't quite be right either. An object's colour cannot simply be identical with its reflectance, because reflectances cut too fine. To uniquely specify an object's colour it is only necessary to determine the three values: hue, saturation, and lightness. To uniquely specify its reflectance, however, requires determining the proportion of the incident light that the object reflects at each wavelength of the visible spectrum. Even sticking to the whole numbered wavelengths, this is roughly 300 values, and becomes an indefinite number if we include all the wavelengths in between. Although in practice it is generally sufficient to determine far fewer values than this to uniquely determine an object's reflectance – at least for naturally coloured objects with smooth reflectance profiles – there is still a significant reduction in dimensionality when we move from reflectances to colours: the very least we need are between 5-7 values, although somewhere nearer 30 is generally more reliable.²⁷

²⁷ Todorović 2002: 66.

Because there is this reduction in dimensionality in the move from reflectances to colours, objects that have different reflectances can, and often do, appear identical in colour under certain circumstances, a phenomenon known as *metamerism*: the surface reflectance profiles of two objects that are metamers in natural daylight are illustrated in Figure 6.2. Metamerism arises from the fact that the human visual system contains just three types of retinal receptor, that register only the total amount of light entering the eye across the broadband wavelengths to which they are sensitive: **S** cones to short-wavelength light, from roughly 400-520nms with a peak sensitivity at 440nms, **M** cones to medium-wavelength light, from roughly 430-640nms with a peak sensitivity at 530nms, and **L** cones to long-wavelength light, from roughly 450-700nms with a peak sensitivity at 560nms. Because the retinal cones are insensitive to variations of wavelength within these bands, any objects that reflect the same overall amount of light across each band width produces the same response in the retinal receptors, and (at least typically) the same colour perception in the subject. The result is that information about individual reflectance properties is lost in the very first stages of visual perception and cannot subsequently be regained.

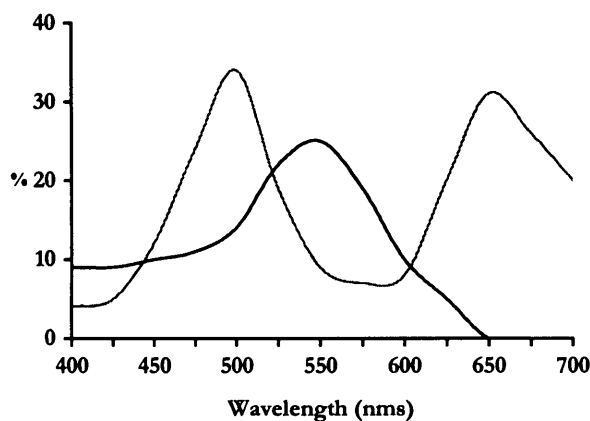


Figure 6.2: Metamerism

The spectral reflectance profiles of two objects that appear identical green to standard observers in natural daylight. Source: Hurvich 1981: 207.

The problem of metamerism leads most physicalists to distinguish reflectances in a more coarse-grained way than by straightforward identity or difference. Because it is colour as it is perceived by normal human observers in

which we are interested, physicalists therefore attempt to delineate reflectances into kinds with reference to the responses of normal human subjects. So identified, reflectance-types are not in any sense ‘natural’ from the perspective of physical science: they are not the kinds of properties that, without reference to human subjects, there would be any reason to single out. But so long as we understand ‘physical’ in a sufficiently distended sense, to include not just the properties quantified over in physical theory but disjunctions of these properties, these properties are still physical properties. More to the point, they are physical properties that are still robustly mind-independent. Even though these properties are type-identified with reference to human responses, they would still exist even in the absence of these responses: they are just one set of reflectance-types amongst indefinitely many sets of reflectance-type, all of which supervene on the total set of reflectances, but not all of which enjoy even the limited anthropocentric privilege of those identified to be the colours.

The important question is rather whether reflectance-physicalism fares any better than simple wavelength-physicalism when it comes to respecting the Inheritance Thesis. Ultimately, it turns out that it does not.

It is natural to suppose that the facts about perceiving subjects the physicalist uses to delineate reflectances into anthropocentrically defined kinds should themselves be physical facts. Generally speaking, whatever motivation there is to think that colours are physical properties is likely to be a motivation to think that our colour experiences are also physical: if, for instance, there are any doubts about the causal intelligibility of *sui generis* colours, then there should be parallel doubts about the causal intelligibility of *sui generis* colour experiences. More specifically, wedding physicalism about colours with a non-physical theory of colour experience does not sit happily with the Inheritance Thesis. If mind and matter differ fundamentally in kind then it is difficult to see how the Inheritance Thesis could be true: how, that is, colour experience could simply inherit its qualitative character from that of which it is an experience if colour and colour experience are really that different. As we saw in §1.5, this combination of views is much more naturally associated with the well-worn strategy of ‘kicking the qualitative upstairs’: it is most naturally associated with the idea that there is some reason, given their qualitative nature, why colours cannot reside in the extradermal material world. To kick the

qualitative into the mind, however, is just to admit that colour experiences do *not* inherit their character from that of which they are experiences after all.

With these kinds of consideration in the background, the most popular versions of reflectance-physicalism delineate reflectances into kinds with reference to the visual processing mechanisms that underlie colour experience, and opponent-processing mechanisms in particular: the two chromatic and one achromatic neurophysiologically realised psychophysical channels in which the signals from the three types of retinal receptor are processed. The rationale for this is simple. These processing mechanisms are obviously themselves physical. Moreover, they hold out the prospect of explaining many distinctive features of colour experience, including for instance the opponent structure of the hues as well as the related unique-binary distinction. The reason why red and green, and blue and yellow, are incompatible, for example, is that the chromatic channels can code for only *either* red or green and only *either* yellow or blue: they cannot code for both red and green, or both yellow and blue. Hence, there cannot be red-green or yellow-blue colour experiences. In contrast, the mutual independence of the two chromatic channels means that there *can* be experiences of the binary hues: orange, cyan, chartreuse and purple. At the same time, just as activity in the yellow-blue channel does not preclude activity in the red-green channel, neither does activity in one channel presuppose activity in the other. The result of activity in just one channel is the experience of a unique hue: a hue that appears to be a perceptual mixture of no other colours.

With this in mind, it is common for physicalists to identify colours with those properties in virtue of which objects reflect light that issues in the relevant opponent-processing. Using as an illustration the over-simplified model of opponent-processing that has entered the philosophical consciousness through Hardin, for instance, an object is unique red according to this account if the light (from an equal energy light source) it reflects in the region of the spectrum to which **L** cones are sensitive (call this region **L***) is (significantly) greater than the light it reflects in the region to which **M** cones are sensitive (**M***), and the sum of these values is equal to the amount of light the object reflects in the region of the spectrum to which **S** cones are sensitive (**S***). The first condition entails that the red-green opponent channel codes for red: if, in contrast, **M***>**L*** then it codes for green, and if **M***=**L*** then it codes neutral. The second condition entails that the

yellow-blue channel codes neutral: if, in contrast, $(L^*+M^*)-S^*>0$ then the yellow-blue channel codes for yellow and if $(L^*+M^*)-S^*<0$ then it codes for blue.²⁸

The reflectance-physicalist's appeal to opponent-processing mechanisms to delineate reflectances into anthropocentrically defined kinds raise specific problems; more general problems with this approach are considered below. The specific problems centre around the fact that opponent-processes are relatively low-level processes, the output of which correspond only imperfectly to full-blown colour experiences. Type-identifying reflectances in terms of opponent-processes therefore makes it difficult to avoid convicting visual experience of systematic error, thereby making violations of the Inheritance Thesis difficult to avoid.

Opponent-processing corresponds roughly to processing that occurs at what Marr calls "the image-based stage". At this stage of visual processing, properties are not yet represented as properties of surfaces located in three-dimensional space (the so-called '2½D Sketch'), let alone as properties of three-dimensional objects. Instead, colours can be thought of as represented occupying a two-dimensional plane perpendicular to the line of sight, lacking texture, and at no depth from the eye.²⁹

We can therefore get an insight into what is lost, if in trying to delineate surface reflectance properties into anthropocentrically defined kinds, we restrict our attention to low-level colour processing mechanisms, by considering *film colours*: colours seen in *aperture mode*. Depending in part on the conditions under which they are seen, and in part on the kind of entity of which they are a property, colours differ in their *mode of appearance*. Most of the colours that we see are *object colours*, and *surface colours* in particular: they are seen in surface mode, as properties of solid opaque objects, or entities like clouds which are at least perceived as opaque objects. Surface colours are perceived as spatially located properties with a certain 'texture' – they follow the contours of the body they are a property of. They offer, as Katz puts it, "resistance" to the eye, presenting "a barrier through which the eye cannot pass".

²⁸ See, for example, Tye 2000 and McLaughlin 2003. The views of Byrne and Hilbert discussed in below §6.4 are in many ways similar. Something like this idea is also canvassed by Smith 1987, although Smith's proposal differs in identifying colours as dispositions to produce the right kind of psychophysically characterised experience, rather than dispositions to reflect the light in such a way as to issue in the right kind of psychophysically characterised experience. For completeness, I should also mention that if $L^*+M^*>0$ then the achromatic channel codes white, if $L^*+M^*<0$ then the achromatic channel codes black, and if $L^*+M^*=0$ then the achromatic channel codes "brain grey".

²⁹ See Marr 1982, and for discussion, Palmer 1999a.

Object colours contrast in this respect with *aperture* or *film* colours, that are perceived under reduction screens and in uniform expanses of colour like clear blue skies. Film colours are generally perceived as textureless properties that lie in a plane perpendicular to the direction of vision – as Katz puts it, they do not lose their “essentially *frontal-parallel* character” – and are perceived either at no depth, or at best no determinate depth, from the eye.³⁰

Film colours at least vary in hue, saturation and brightness: it is for this reason that it seems reasonable to call them colours at all. Yet there are important differences between colours perceived in surface mode and aperture mode. If nothing else, not every colour that has a location in colour space can even be seen in aperture mode. The perception of the ‘pure’ contrast colours, black, white, grey and brown, in particular depends upon organisational properties of the perceived scene that are generally eliminated by viewing colours under this mode of presentation. To perceive something as brown or black, for instance, requires perceiving it against a lighter background. Conversely, to be seen as white, objects needs to be perceived against dark backgrounds.

Identifying colours with reference to low-level opponent-processing mechanisms leads naturally to the position popular amongst visual scientists that an object’s real colour is the colour it appears to have in aperture mode, after the effects on perceived colour of properties of the visual scene have been eliminated; accordingly, that our experiences of pure contrast colours in particular are almost always illusory.³¹ Tye exemplifies this tendency. Tye identifies black, white, grey and brown with their opponently-processed surface reflectance properties, and the colours that we normally see with compound, partly relational properties whose existence depends in part upon the obtaining of factors extrinsic to their bearers. According to Tye, something is really black, for example, if it reflects about 5% of the incident light that strikes it at each spectral wavelength. It is the pure contrast colour BLACK, however, just in case it is black and darker than its surroundings. The property BLACK – the property that we normally perceive – is therefore parasitic on the real colour, black, a property which we only veridically perceive when we eliminate the contrast effects which partly constitute the compound pure

³⁰ For a more detailed taxonomy of the modes of appearance of colour, see Katz 1911: especially 7-28.

³¹ In a recent textbook on colour perception, for instance, Kaiser and Boynton describe the colours that objects appear as a result of this kind of simultaneous contrast as “subjective colours”; 1996: 33-5.

contrast properties. Furniture in an unlit room is therefore black, but not BLACK. By parity of reasoning, an enveloping light brown fog is brown, but not BROWN. And so on.³²

If only from the perspective of Tye's wider project, there is something deeply puzzling about this attribution of widespread perceptual illusion to visual experience. Part of Tye's own argument for an intentionalist ("representationalist") theory of perception is that it is "just not credible" to suppose that visual experience is systematically misleading in the way required by sense-datum theories of perception.³³ The kind of error postulated by sense-datum theories of perception differs from that required by Tye to explain our perception of the contrast colours: the first case involves the *necessary* confusion of one *object* for another, whilst in the second case the error lies in the *almost inevitable* confusion one *property* for another. But if, as Tye appears to suggest, the argument against the sense-datum theories is merely an inference to the best explanation – it is much more plausible to suppose that visual experience is not systematically misrepresentative – then the argument should generalise. If it is more plausible to suppose that visual experience is not systematically misleading in the one case, then the same should hold across the board.

There is also something odd about this kind of response more generally. The physicalist is trying to delineate reflectances into anthropocentrically defined kinds on the basis of certain types of human response. We are, however, working with a *carte blanche*: we *could* carve the reflectance properties of objects in any number of ways. Why, then, carve them in a way that has the result of convicting perceptual experience of widespread, systematic error? On this view, the human visual system is found guilty of typically misperceiving properties that are, in the first place, anthropocentrically defined: it is found guilty of misperceiving properties that are such as to be perceivable *only* using peculiarly human perceptual apparatus. If we're already sorting reflectances into gerrymandered kinds in order to guarantee the veridicality of colour experience, then it least seems that we should get these kinds right.

³² Tye 2000: 150-162.

³³ 2000: 46.

The odd position in which we find ourselves at this point is symptomatic of the fascination with low-level processing mechanisms. And it is not just accommodating contrast effects that this excessively narrow focus renders problematic, either. Opponent-processing mechanisms do not even explain why colours typically appear to us in surface mode, as properties *of* objects spatially localised in three-dimensional space. At best, the perceived distance of film colours from the eye is indeterminate, like the perceived distance of the blue of a clear sky. At worst, film colours are perceived at no depth whatsoever. If colour processing terminated after opponent-processing at roughly the image-based stage, we could expect that colours would be seen as merely overlaying objects, and not as properties *of* those objects. We might, for instance, expect our colour perception to be like that of the subject with a cerebral lesion reported by Gelb. For this subject, the colours of objects effectively assumed the character of unlocalised film colours: the patient reported having to reach ‘into’ the colours of objects in order to touch their surfaces.³⁴ But clearly, this is not how the rest of us perceive colours.

Now this is not to say that the existence of opponent-processing mechanisms are inconsistent with the phenomenology of colour experience: that opponent-processing *entails* that colours should be perceived as overlaying objects, and therefore that opponent-process theory must be false. The problem is rather that of itself, opponent-process theory is *neutral* as to many of the features that colours are perceived to have. Further colour-processing occurs subsequent to the opponent-processes touted by many reflectance-physicalists. And if so, then it is unsurprising that the physicalist who delineates reflectances simply with reference to opponent-processes mis-identifies colours as they are actually perceived.

The natural response in light of these problems is to sort colours into reflectance-types, not on the basis of low-level visual processing mechanisms, but instead with reference to visual processing more generally construed, or indeed, perhaps just colour experiences themselves; at least so long as we are sure that these experiences are physical. At this point, however, a more fundamental problem with reflectance-physicalism rears its head. The problem is that in *whichever* reflectances are type-identified, they do not seem to respect the thesis that colour experience inherits its qualitative character from that which it is an experience of.

³⁴ For discussion, see Katz 1911: 14.

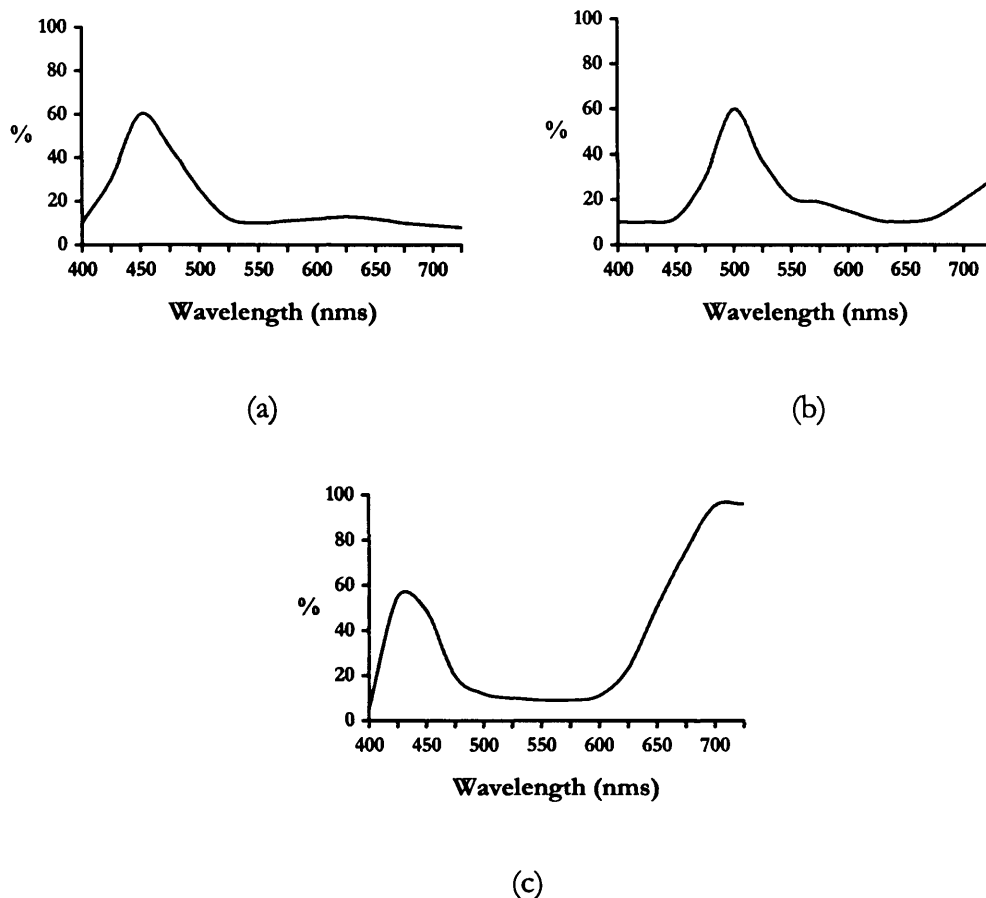


Figure 6.3: Sample Surface Reflectance Profiles

Object (a) is blue, (b) green and (c) purple.

Source: Hurvich 1981: 43.³⁵

Consider, by way of illustration, the similarity relations between the colours. The reflectances with which the reflectance-physicalist identifies colours do not obviously themselves stand in anything like the relations of similarity the colours that we perceive do. Consider the surface reflectance profiles for blue, green and purple, illustrated in Figure 6.3. The reflectance profiles for blue and green are almost structurally identical. Both have a single peak at which they reflect roughly 60% of the incident light, and both reflect very little light in the higher part of the visible spectrum. The main difference between them is just in the location of their peak: blue objects tend to reflect more light in the ‘blue’ part of the visible spectrum, circa 450nm, whilst the peak for green objects is shifted slightly towards the ‘green’ part of the visible spectrum, circa 500nm. This differs markedly from the reflectance profile of purple objects. Like typically blue objects, characteristic purple

³⁵ The profiles Hurvich gives are actually profiles for blue, green and purple lights, but material objects with isomorphic reflectance profiles would look the same.

objects reflect around 60% of the incident light in the ‘blue’ part of the visible spectrum, circa 450nms. Unlike both blue and green objects, however, a standard purple object has another, even sharper peak, in the ‘red’ part of the visible spectrum, by the time it reaches 700nms reflecting around 80% of the incident light that strikes it. Judging from their reflectances, it would be natural to suppose that the blue object is more similar in respect of colour to the green object than it is to the purple object. Yet this is false. In fact, blue is more similar to purple than to green: indeed, purple is a binary hue of which blue is a component.

With this problem in mind, some reflectance-physicalists effectively just despair of ever recovering the relevant similarity relations from reflectance properties, claiming instead that the truth of similarity claims about colours are ultimately just parasitic upon the truth of the corresponding claims about colour experience. As McLaughlin puts it, the similarity claims are true “*de dicto*, not *de re*”: they are true of the physical properties that produce colour experiences only insofar as they produce colour experiences of which these claims are true, they are not true of these properties essentially.³⁶

But this raises even more problems. For one thing, it is incumbent upon the physicalist to explain how the truth of similarity claims about the colours could be parasitic upon the truth of perceived similarities in a way that is consistent with the original requirement that colour experiences be themselves physical: it would, remember, be an odd combination of views to hold that colours are physical reflectance properties and yet also hold that the colour experiences with reference to which we type-identify reflectance properties are themselves non-physical. A natural thought is that we can explain colour perception as the perception of certain physical properties under a subjectively determined mode of presentation. But note that this talk of modes of presentation cannot just be a way of sneaking in through the back door the kind of intrinsic non-representational properties of experience that are generally considered to be inconsistent with a physicalistically acceptable theory of perception.³⁷

A deeper problem, however, is that this response simply renounces any pretensions that we might have of respecting the Inheritance Thesis: it is just to

³⁶ 2003: 111-16. See also Jackson 1998: 111.

³⁷ Shoemaker 2003 argues that representationalist theories of perception are actually consistent with the existence of what he calls “functional qualia”, but this is a minority position.

concede that colour experiences do not inherit their qualitative character from the properties that they are experiences of after all. If nothing else, this makes the physicalist's position surprisingly non-naturalistic. It involves calling into question the deliverances of an absolutely basic natural cognitive faculty. In contrast, the guiding assumption of computational theories of vision like those proposed by Marr, whose insights physicalists are generally keen to exploit, is that the representations in which the computational process culminates are largely veridical. Clearly, if the computational task of vision is to determine "what is present in the world, and where it is", then the visual system succeeds in this task only if the representation of the objects, events and their properties that the mind produces is accurate: if the way the world is presented as being is the way it really is.³⁸ Renouncing the Inheritance Thesis just non-naturalistic. It violates a wholly common sensical explanatory constraint. Although this ultimately may not be a damning indictment of reflectance-physicalism, it would clearly be preferable if our theory of colour did not have this rather unfortunate consequence.

4. The Similarity Phenomena

Assuming for the time being that reflectance-types do not in fact stand in anything like the right relations of similarity and difference – the assumption is one that I will actually return to §6.5 – we need to consider in slightly more detail the datum that needs explaining. It has been suggested that we can account for *similarity phenomena* – the sorting of coloured chips, assenting to propositions such as 'yellow is more similar to orange than either are to blue', and so on – without assuming that we actually perceive colours as themselves standing in the relevant relations of similarity and difference. Rather, the suggestion goes, the similarity phenomena have their footing in perceptual experiences of some other kind. If this is right, then it offers a way of squaring reflectance-physicalism both with the Inheritance Thesis and the assumption that reflectance-types do not stand in the right relations of similarity and difference. These claims will not be in direct conflict, because there will be no reason to suppose that the colours *genuinely* stand in the relevant relations at all.

³⁸ Marr 1982: 3.

According to one version of this strategy, for instance, the similarity phenomena have their basis in the perception of anthropocentrically identified reflectance-types of differing levels of generality. Reflectances can be anthropocentrically type-identified in a number of different ways. We can, for instance, type-identify reflectances at the level of the superdeterminable *coloured*, the determinables *reddish*, *yellowish*, *blueish*, *greenish*, *whiteish* or *blackish*, the determinates *yellow*, *green*, *olive*, *chartreuse*, or the superdeterminates *yellow₁₃*, *pink₅₄*, *ideal black*, *Munsell Blue-Purple*. With this in mind, Byrne and Hilbert have suggested that it may be possible to explain the similarity and difference relations that we judge to hold between the colours in terms of the perception of common properties of these kinds: coloured objects – and therefore derivatively colours – are more similar the more of these properties they are perceived to instantiate. Take, for example, a slightly orangey-yellow, which we can call *yellow₁₃*. An object that instantiates the super-determinate property *yellow₁₃* also instantiates the determinate property *yellow*, the determinable properties *yellowish* and *reddish*, and the superdeterminable property, *colour*. *Yellow₁₃* therefore turns out to be more like unique yellow than unique blue because unique yellow and *yellow₁₃* co-instantiate more of the same properties than unique blue and *yellow₁₃*: the former share determinate, determinable and superdeterminable properties, whereas the latter share only superdeterminable properties.³⁹

Byrne and Hilbert have since rejected this proposal because it does not explain the similarity phenomena in the right way. The problem is that what is doing the work are not facts about how coloured objects look, but further facts about perceiving subjects. For instance, the similarity phenomena depend not only on subjects registering the comparative number of colour properties that coloured objects instantiate in the first place, but then making their similarity judgements on this basis. If either of these further conditions failed to hold, then subjects should be able to abstain from making similarity judgements, or perhaps even make the wrong similarity judgements, in a way that we do not think is possible. There does not seem

³⁹ Byrne and Hilbert 1997b. My terminology differs slightly from that of Byrne and Hilbert in two respects. First, Byrne and Hilbert talk of perception in terms of ‘representation’. Here, as elsewhere, I am neutral on theories of perception, and so substitute ‘perception’ for ‘representation’. Second, Byrne and Hilbert refer to *reddish*, *whiteish* etc as superdeterminable properties, whereas I reserve this term for colour – or more strictly speaking *human-colour*, given that different species can perceive determinates of different determinable colour properties (§4.2).

to be this room for error or hesitation: when we are presented with yellow, orange and blue Munsell chips we have no option but to judge that the yellow and orange chips are more similar to each other than either is to the blue chip.⁴⁰

In a more recent variation on this proposal, Byrne and Hilbert therefore identify colours instead with immediately perceived types of ‘magnitude’. On this view, (determinable) colours are thought of as properties like lengths that constitute sets or magnitudes, the members of which can be ordered in a way that reflects the relationship between the distinct elements. Take, by way of illustration, a range of hue samples of constant saturation and lightness. These hue samples can be ordered to reflect the proportions of each of the phenomenologically basic hues – red, yellow, green, blue – that they are perceived to contain. A perfect orange, for instance, will be judged to contain 50% red and 50% yellow. A slightly redder orange, perhaps 75% red and 25% yellow. And, at the limit, a unique red will be judged to contain 100% red and 0% yellow. By taking four different hue-magnitudes – R, Y, G, B – corresponding to the four phenomenologically basic hues, it is possible to classify superdeterminate colours depending on the proportion of these hue-magnitudes that they are perceived to contain. These hue-magnitudes can then in turn be used to type-identify reflectances, in such a way that the reflectances which cause the relevant hue-magnitude experiences constitute anthropocentrically defined kinds.

For instance, reflectances that affect the incident light such as to cause experiences in which objects are perceived as having a proportion of hue-magnitude Y greater than roughly 75% are yellow; a proportion of hue-magnitude R greater than roughly 75% red, and so on (although to allow for vagueness in our colour ascriptions we may not want to be too specific about these values). The similarity phenomena can then be explained in terms of the relative proportions of the hue-magnitudes that different objects are perceived to contain. If one colour sample is perceived as 75Y:25R (i.e. yellow-orange), another as 25R:75B (blue-purple) and another as 80B:20G (greeny-blue), then the second will look more like the third than the first because the second and third samples are perceived to contain 75% and 80% (respectively) of the hue-magnitude B, the first and second samples are

⁴⁰ Byrne 2003: 656-7, n33.

perceived as containing only 25% of the hue-magnitude R, whilst the first and third samples are perceived as containing *no* common hue-magnitude.⁴¹

Common to both these proposals is the thought that the similarity phenomena are explained, not by the perception of similarity relations between colours, but by the perception of *something else*: in the first case common properties, and in the second case hue-magnitudes. These proposals are therefore consistent with the claim that reflectance sets do not themselves genuinely stand in the similarity relations characteristic of the colours. Unfortunately, neither proposal works.

Generally speaking, there is a motivational problem. The default assumption is that we judge yellow to be more similar to orange than blue because we *perceive* yellow to be more similar to orange than blue: when presented with the relevant chips, the similarity simply forces itself upon us. It only really makes sense to say that we can explain colour similarity phenomena in terms of the perception of something other than similarity relations between colours if we suppose that we cannot perceive similarity relations in general. Unless there is a general problem with perceiving similarity relations, there is no independent motivation for the view that we do not perceive similarity relations between the colours: this would be nothing more than an *ad hoc* assumption, made in the face of the objection that the best physical candidates do not themselves stand in the relevant relations.

The question is therefore whether there are any good reasons to give up the default assumption that we perceive similarity relations between colours. Byrne himself offers two arguments for thinking that it could not be the perception of similarity relations that explains the similarity phenomena. The first is that perceiving similarity relations between properties presupposes that properties are themselves amongst the objects of perception. The second, more general problem, is that we can make judgements about similarity on the basis of successive visual experiences, but in successive visual experiences of, say, yellow, orange and blue Munsell chips, there is never any point at which we perceive that the yellow chip is more similar to the orange chip than the blue chip. Neither kind of consideration, however, is entirely persuasive.

⁴¹ Byrne and Hilbert 2003; Byrne 2003.

Byrne's reason for excluding properties from amongst the objects of perception turns on the idea that objects of perception must look a certain way, but that there is no way in which properties look:

how does *the property orange* look? Not orange, or any other colour!...And even if we suppose that the property orange *does* look F (for some filling for 'F'), the question arises of whether we see Fness, and if so, how it looks. If we do see Fness, and it looks G, then the question arises of whether we see Gness, and this regress had better stop somewhere. The most natural place to stop it is at the very start. Persimmons are among the objects of vision; the property orange is not.⁴²

This, however, is not especially persuasive. Although Byrne is right to say that the regress must stop somewhere, it is not clear why it should stop with objects. In particular, it is not clear why there cannot be a way that properties look even though it cannot be further described in terms of properties of that property. What does yellow look like? Well, it looks like *that* (pointing at a sample of yellow). Why suppose that there should be some further thing that yellowness looks to be? Perhaps yellowness just *is* looking like that, and there is no other way of grasping what yellowness is other than by looking.⁴³

Byrne's second argument for thinking that we do not in general perceive similarity relation is similarly inconclusive. To say that when we successively perceive, for instance, differently coloured Munsell chips we do not perceive the similarity relations between them seems to assume that we cannot have dynamic, temporally extended, experiences. The assumption appears to be that we have one experience of a yellow chip, one experience of an orange chip and one of a blue chip, and our experience never extends beyond the presently presented chip. But this is an odd way of typing experiences. It is natural to suppose that we have temporally extended experiences: I can watch a football match, listen to a concert. Indeed, on reflection, it seems that very few of our experiences are static in the way that Byrne's objection appears to require.

⁴² Byrne 2003: 655.

⁴³ The view that properties are not amongst the objects of perception is sometimes defended on the grounds that properties are 'abstract objects'. But this seems to be little more than a dogma. Properties are not *objects*: they are properties, and properties are entities of a different ontological kind to objects. Nor are properties obviously *abstract*: the brownness of my table, for instance, seems no less particular than the table itself; both have a spatio-temporal location, both can be demonstratively identified and reidentified, and so on.

Without independent motivation, the claim that we do not perceive similarity relations specifically between the colours is *ad hoc*. Setting this problem aside, there are more specific problems with the alternative explanations of the similarity phenomena that Byrne and Hilbert propose. In particular, neither proposal explains *all* the similarity phenomena that need to be explained. As we have already seen, colour space is asymmetrical. One of the ways in which this manifests itself is in the differing perceptual distances between the unique hues: unique blue and unique green, for instance, are more similar to each other than either is to the adjacent unique hue (§6.1). Neither of Byrne and Hilbert's proposals are able to explain these similarity phenomena.

According to their original common property proposal, for instance, objects are relatively more similar the more common properties they instantiate. The unique hues, however, have only the superdeterminable property, *colour*, in common: there is no determinable property – reddish, yellowish, blueish, greenish, blackish or whiteish – that unique blue and unique green have in common, but that, say, unique blue and unique yellow lack. It therefore follows from the common property proposal that the unique hues should be maximally different. But they are not: green is more similar to blue than yellow and blue more similar to green than red.

The situation with respect to the magnitude proposal is no better. The idea of identifying colours with types of magnitude derives from the Swedish Natural Colour System (NCS), the system of colour classification most widely used in Scandinavia. The NCS categorises colours according to the proportion of the elemental colours identified by Hering – the unique hues, plus black and white – that they are perceived to contain. The result is that the hue circle is best understood, not as one continuous scale, but as four independent scales: red-yellow, yellow-green, green-blue and blue-red. As the co-founder of the NCS, Lars Sivik, remarks:

Conceptually and cognitively the bipolar relationship between yellow and red is different from the bipolar relationship between red and blue and therefore constitutes another scale.⁴⁴

⁴⁴ Sivik 1997: 173.

But this makes direct comparison of the different scales strictly speaking impossible. It is not, for instance, possible to compare hue samples that lie on different axes, like red, orange and blue. Moreover, neither is it possible to compare the unique hues themselves. Whatever the prospects for extending the NCS to inter-axis comparison, there is absolutely no way of extending this model to cover comparisons between the unique hues: unique blue and unique green, like unique yellow and unique red, are not perceived as containing *any* proportion of any other hue magnitude. Therefore the magnitude proposal also predicts, contrary to the empirical facts, that these colours are maximally different.

5. Selection-Physicalism

The attempts to identify colours with physical properties considered so far have assumed that the relation between objects and subjects is, so to speak, all one-way traffic: that colour perception is simply a matter of perceiving subjects *detecting* properties of objects in their environment. These views do not consider the possibility that facts about the perceiving subject may in the first place determine relevant facts about properties in the world that the visual system tracks.

According to the view developed by Hilbert and Kalderon, in contrast, it is facts about the visual system – which facts can for present purposes be left indeterminate – that in the first place determine the relations of similarity and difference in which colours are perceived to stand. These relations partly fix the character of our colour experiences, such that what makes an experience an experience of a particular colour is in part all the similarities and differences that the colour exhibits in relation to all the other colours. But this, it is claimed, does not mean that the world makes no contribution, as these experiences in turn determine which reflectance-types colours are identified with, fixing which sets of pre-existing similarity relations between objects “*count as* similarities with respect to colour”. Crucially, the similarity relations the visual system picks out in this way are themselves wholly objective. They are in no sense *brought into being* by being selected by a given visual system, they are just one of indefinitely many sets of similarity relation that supervene on the physical reflectance properties of objects. Because these similarity relations are themselves wholly objective relations, this means that

they can still play a role in explaining the character of our colour experiences, even though it is the visual system which in the first place selects which relations are to count as relations of similarity with respect to colour: it is *because* the objects that are selected to be similar in respect of colour *really are* (in some respect) similar, that they are perceived to stand in precisely the similarity relations they are perceived to stand in.⁴⁵

This proposal in effect combines a form internalism about colour experience with a form of externalism: it attempts to acknowledge a role for the visual system in fixing the relations of similarity and difference in which colours are perceived to stand whilst at the same time trying to square this with the thought that visual experience owes its distinctive character to that which it is experience of. The question is whether this combination of views is ultimately stable. Can we hold onto the insight that the visual system *selects* which properties are colours whilst at the same time respecting the Inheritance Thesis? In the end I will argue that we can, but this will only be at the expense of any reductive aspirations that we might have: objective similarity relations will be able to explain the perception of similarity only if the properties that we select are colours *as such* (*sui generis* properties), and not type-identified reflectances.

Hilbert and Kalderon's account of the perceived similarity relations between colours trades on the fact that similarity is cheap. Anything is similar to anything in at least some respect. Hilbert and Kalderon exploit this by allowing perceiving subjects to determine which of the indefinitely many similarity relations that hold between objects are to count as *the* similarity relations definitional of the colours. It is really this, however, that lies at the heart of their difficulties. Stated abstractly, the problem is that in the end they just do not take the similarity relations that hold between the colours seriously enough: not just any set of similarity relations *could* count as the relations of similarity between the colours.

It is important to realise how weak the constraints on which properties a perceiving subject can select to be the colours according to Hilbert and Kalderon are. Because similarity is cheap, the same reflectance-types stand in indefinitely many different sets of similarity relations. On Hilbert and Kalderon's account, this means that the very same reflectance-types can be selected to be as many different colours

⁴⁵ 2000: especially 196-9. For discussion, see Shoemaker 2003.

as there are similarity orderings in which they stand: there is nothing about the reflectance-types as such that imposes any further constraints on which similarity orderings they can be selected to stand in. As the number of colours any given set of reflectances can be identified with multiplies, however, it becomes increasingly difficult to hold onto the idea that colour experiences simply inherit their qualitative character from those properties.

On the one hand, it follows from Hilbert and Kalderon's view that two different sets of reflectances could be selected by different subjects to stand in structurally isomorphic property spaces. Because the character of a colour experience is partly determined by all the relations of similarity in which the perceived colour stands, the experiences of these subjects are qualitatively identical. Because the character of their experiences is also partly determined by the external properties that their experiences are experiences of, it follows that their qualitatively *identical* experiences thereby inherit their identical qualitative characters from *different* sets of reflectances. Suppose that one subject's colour perception is shifted relative to that of another: for instance, that objects Jack perceives as unique yellow Jill perceives as yellow-green, objects Jack perceives as yellow-green Jill perceives as unique green, objects Jack perceives as unique green Jill perceives as green-blue, and so on. Hilbert and Kalderon's account predicts that Jack and Jill thereby veridically perceive different sets of reflectances as qualitatively identical.⁴⁶

Conversely, it follows from Hilbert and Kalderon's account that different perceivers could veridically perceive the same set of reflectances as qualitatively different. Two subjects could select the very same set of reflectances to feature in differently structured property spaces. Because the character of a colour experience is partly determined by all the relations of similarity in which the perceived colour stands, the experiences of these two subjects differ in their qualitative characters. Because the character of their experiences is also partly determined by the external properties that their experiences are experiences of, it follows that their qualitatively *different* experiences inherit their different qualitative characters from the very *same* set of reflectances.

⁴⁶ Mark Kalderon tells me that selection-physicalism was originally formulated to solve the location problem for the unique hues. I have already suggested that there are independent problems with treating intra-species variations as faultless disagreements (§5.1).

To suppose that reflectance-types can genuinely confer their qualitative character onto myriad colour experiences in this way presupposes that reflectance-types have *multiple qualitative characters*: that the same set of reflectances can produce qualitatively different veridical experiences because reflectance-types *really are* all the ways they appear to be in these qualitatively different experiences.⁴⁷ If nothing else, this makes for bad explanation. If an experience could have been an experience of the very same property and yet differed in its qualitative character, or else been an experience of a different property and had the very same qualitative character, then the property the experience is an experience of effectively just drops out of the explanation of why the experience is the experience that it is, and not some other. The fact that the experience is an experience of that very property, it seems, is irrelevant to its being the experience that it actually is.

This explanatory problem conceals a deeper metaphysical problem. The reason why the explanation seems unsatisfying is that the selected reflectance-types are not appropriately related. To suppose that the very same property can stand in many different sets of similarity relation trivialises the idea that the relations of similarity and difference in which colours stand are genuine internal relations. Internal relations are not just any old relations of similarity and difference. Internal relations necessarily supervene on properties because of the intrinsic nature of those properties. The problem is that there is nothing about reflectance-types which can explain their being such as to stand in the similarity relations that perceiving subjects can select.

It helps to get a firmer grip on this problem by considering how Hilbert and Kalderon deal with the limiting case of inter-personal variation: spectral inversion. Hilbert and Kalderon claim that the possibility of spectral inversion is something that their account of colour forecloses. According to Hilbert and Kalderon, the character of a colour experience is in part determined *relationally*, by all the relations of similarity and difference in which the colour is perceived to stand. If the character of an experience is determined relationally, then there could be no difference in the character of that experience if the psychological colour space were symmetrical: two experiences that stood in all the same relations would simply be the same experience. As it is a necessary condition of (at least undetectable) spectral inversion

⁴⁷ Shoemaker 2003: 269.

that colour space be symmetrical, Hilbert and Kalderon conclude that spectral inversion is impossible. The only way to avoid this conclusion, they argue, would be to posit intrinsic phenomenal features of experience that are “in no need of a relational characterisation in terms of phenomenal similarity”; features of experience like *qualia* that are in some sense distinct from the properties experienced, and therefore capable of individuating colour experiences independently of the similarity relations in which they stand. But, Hilbert and Kalderon object, that there are such properties of experience was supposed to be the conclusion of the Inverted Spectrum Argument, and not an assumption of it.⁴⁸

There is, however, something deeply puzzling about the dialectical situation at this point. Although, as a matter of sociological fact, spectral inversion is generally used to argue for the existence of non-representational features of experience, or *qualia*, there is something very odd about this. If we accept the Inheritance Thesis, then perceptual experiences inherit their qualitative character from what they are experiences of. Consistent with the Inheritance Thesis, the inverted spectrum argument should therefore tell us less about the nature of conscious experience than the nature of the *properties* of material objects on which experience is directed.⁴⁹ This, for instance, is perfectly consistent with the etymology of *qualia*, which comes from the Latin *qualis*, meaning just ‘of such a kind’. Etymologically, that is, there is no reason why *qualia* should refer to properties of experience rather than properties of material objects. Indeed, before the rot of expunging qualitative properties like colour from the material world set in, this is exactly how the word *was* used. In the middle of the seventeenth century, the Gassendist Walter Charleton, for instance, defines quality of a compound (non-atomic) *material body* as:

*that kind of Appearance, or Representation, whereby the sense doth distinctly deprehend, or actually discern the same, in the capacity of its proper Object. An Appearance we term it, because the Quale or Substness of every sensible thing, receives its peculiar determination from the relation it holds to that sense, that peculiarly discerns it.*⁵⁰

To deny, as Hilbert and Kalderon do, the logical possibility of spectral inversion is in effect to make a strong metaphysical claim about the properties from which visual experience is supposed to inherit its qualitative character. It is to claim

⁴⁸ 2000: 208.

⁴⁹ Compare the earlier aside on the knowledge argument in §3.3.

⁵⁰ 1654: 128-9.

that the *perceived properties of material objects* could not themselves be such as to realise a symmetrical property space. And this is just to fail to take similarity relations between the colours seriously. To deny that the properties experienced could realise a symmetrical property space is to deny that there is anything more to properties than the similarity relations in which they stand. It is to hold an essentially relational theory of properties: if there were something to the reflectance-types ‘over and above’ the similarity relations in which they stood, then this something extra would serve to distinguish between sets of structurally isomorphic properties; it would serve to individuate the properties non-relationally. Denying that there is anything more to properties over and above the similarity relations in which they stand is to deny that there are any facts on which the similarity relations supervene. But if there is nothing more to properties than their standing in certain sets of similarity relation then there are no intrinsic features from which these relations can ‘flow’.

Hilbert and Kalderon succeed in avoiding these problems only by politely shelving the externalist aspect of their account, as, for instance, when they claim that:

A complete, empirically adequate quality space is an *exhaustive* representation of the phenomenology associated with a given sensory modality. The phenomenal character of an experience aligned on a point of that space is represented by its position in the quality space.⁵¹

To renounce externalism, however, is to give up any pretence of trying to respect the Inheritance Thesis. If the character of experience is wholly determined without any reference to the properties on which an experience is directed, then those properties simply play no role in explaining the nature of that experience after all: the very same experience could have occurred even if those properties had never existed. This is therefore to convict common sense of error.

The idea that we can think of the visual system as *selecting* the colour properties that it perceives is not, for all this, unattractive. We have already seen, in relation to inter-species variation in colour perception, for example, that this is a useful way of thinking about differences in colour perception across the animal kingdom (§4.5). The moral to draw from the discussion of selection-physicalism, however, is that we cannot think of the visual system as selecting just anything to be

⁵¹ Hilbert and Kalderon 2000: 208.

the colours. That which the visual system selects to be the colours have to be able to explain *in the right way* the similarity relations that we perceive colours to stand in. The only properties capable of doing this are the colours *as such*. It is only the colours *as such* that have the qualitative characters necessary to ground the internal relations in which colours stand. The adequacy of our common sense conception of colour therefore requires that colours be *sui generis* properties, distinct from the physical reflectance properties of objects.

[7] Colour and its Place in Nature

Epiphenomenalism...supposes something to exist in nature which has nothing to do, no purpose to serve, a species of *noblesse* which depends on the work of its inferiors, but is kept for show and might as well, and undoubtedly would in time be abolished.

Alexander 1920 ii: 8.

I have argued that the truth of our common sense thought about colour requires that colours be *sui generis* mind-independent properties. This finally brings us back to the problem with which we started, the problem of locating colours within the natural world. It was the problem of finding a place for *sui generis* mind-independent colours in the natural order than led mechanists like Descartes and Locke to accord colours secondary quality status in the first place. Although the details of physical theory have changed considerably since the seventeenth century, the idea that our ontological commitment is ultimately determined by our best physical theory has not. According to this way of thinking, what exists is just what physical theory tells us exists. Hence, if *sui generis* mind-independent colours have no place within physical theory, they have no place within the material world.¹

To address this challenge, we need to show that the *sui generis* nature of colour is no bar to its existence. If nothing else, this requires securing an intelligible role for colours in explaining why it is that material objects appear the way they do. A popular reason for thinking that *sui generis* colours cannot explain why colours appear the way that they do – the *causal exclusion argument* – is set out in §7.1. A popular response to this argument – *realisationism* – is rejected in §7.2, where I argue that we can only avoid the force of the causal exclusion argument in this way if we sacrifice the claim that colours are genuinely distinct from an object's physical properties. Instead, I suggest in §7.3 that the causal exclusion argument only shows colours to be causal epiphenomena if we fail to distinguish clearly between properties located at different 'levels of nature'. The propriety of 'levels of nature' talk is defended in more detail in §7.4, where I argue that the emergence of *sui generis* properties at higher levels of functional organisation is as intelligible as we have reason to expect it must be. Finally, §7.5 draws some general conclusions from the thesis as a whole.

¹ This pattern of argument forms a common – albeit often implicit – background to many discussions of colour. For more or less explicit statements of this argument, see, for example, Mackie 1976, Jackson 1977, Boghossian and Velleman 1989, Johnston 1992.

1. Supervenience

I argued in Chapter 6 that colours are distinct from the physical reflectance properties of objects. But to say that colours are distinct from an object's physical properties is to merely make a negative claim. It is to say something about how colours and reflectances are *not* related; namely that they are not identical. It would be nice if we could have a more positive account of this relationship.

In particular, the important question that we need to settle is whether there is any sense in which colours, though distinct from reflectances, nevertheless depend upon these properties. A common way of capturing this idea of dependency is via the notion of *supervenience*. One set of properties supervenes on another set of properties just in case there can be no difference in the supervenient properties without a corresponding difference in the properties on which they supervene. As G.E. Moore, discussing the relationship of *sui generis* moral properties to natural, non-normative properties, puts it:

if a given thing possesses any kind of intrinsic value in a certain degree, then not only must the same thing possess it, under all circumstances, in the same degree, but also anything *exactly like it*, must, under all circumstances, possess it in exactly the same degree. Or, to put it in the corresponding negative form: it is not *possible* that of two exactly similar things one should possess it and the other not, or that one should possess it in one degree, and the other in a different one.²

Supervenience relations come in a variety of strengths depending on whether they are defined within, or over possible worlds, and if they are defined over possible worlds, whether they are defined over *all* possible worlds, or merely over some subset of these worlds, such as those worlds in which the actual laws of physics hold. To simplify matters, however, we will just consider the strongest kind of supervenience relation, a *metaphysically* (or *logically*) *necessary supervenience relation*, which entails there is no world exactly like ours in all physical respects that differs in any other respect.

It follows from necessary supervenience that supervenient properties like colour, or the psychological more generally, are fully determined by the physical: that the nature of the colour world is a consequence of the way the physical world

² 1919-20: 261.

is. If, in contrast, the necessary supervenience of colours on reflectances is false, then colours in some sense ‘float free’ from their reflectance bases; they lack any ‘anchor’ in physical reality. There could, for instance, be a systematic permutation of colour with respect to reflectance, with the reflectances colours are associated with varying over, and perhaps even within, possible worlds. There could even be a world in which there are reflectances but no colours whatsoever: the chromatic equivalent of a zombie world, in which there are brains physically identical to ours but no consciousness.

At least some form of colour-reflectance variation certainly seems conceivable. It is perhaps more controversial whether we can conceive of a chromatic zombie world, given that this would involve conceiving of material objects without thinking of them as coloured, something that is often thought to be a notoriously difficult imaginative feat to accomplish.³ But these worries do not touch the conceivability of a straightforward permutation of colours and reflectances. Indeed, it follows from the argument of Chapter 6 that there is no straightforward conceptual bar to reflectances and colours coming apart in this way. If reflectances lack the structural features characteristic of perceived colours then it is at least conceptually consistent to suppose that any reflectance should be associated with any colour, or even that reflectances should be associated with no colours whatsoever. Had there been isomorphic structural features such as the distinction between unique and binary hues at the level of reflectances, this would have set constraints on which colour-reflectance combinations were permissible. As the structural features of colour have no analogues at the level of reflectances, however, the reflectances set no such constraints.

Still, even though colour-reflectance variation is conceivable, there is good reason to accept the claim that colours supervene of necessity on reflectances. At best, the conceivability considerations, for instance, show only that there is a conceptual distinction between colours and reflectances: that we can think of colours without thinking of reflectances and *vice versa*. But this conceptual claim does not of itself entail the metaphysical claim that colours and reflectances are capable of independent variation. Indeed, as we have already seen in §5.5, this kind of conceptual distinction does not even strictly speaking entail that the referents of

³ See the discussion of Cavendish and Berkeley in §1.4.

these concepts are distinct, but co-extensive, properties: it would be consistent with the conceivability that they are just different aspects of the same property.

More to the point, the necessary supervenience of colours on reflectances has already proved important in defending the mind-independence of colour in the face of the Argument from Perceptual Variation. In response to variations in perceived colour that are the result of differences in the illumination, for instance, the supervenience of colours on reflectances secures a correlation between those circumstances in which full and accurate information about an object's reflectance reaches the eye and those situations in which its real colour is revealed, thereby grounding a non-arbitrary preference for natural daylight as the illumination that best reveals the real colours of objects (§3.4). Anything less than the *necessary* supervenience of colours on reflectances here, however, would be insufficient. If an object's real colour is not necessarily determined by its reflectance, then facts about its reflectance do not guarantee the relevant facts about its colour. Whether the light reflected by an object to the eye carries full and accurate information about its colour would therefore be irrelevant to the question of whether its real colour is revealed in those circumstances.

More generally, denying the necessary supervenience of colours on reflectances is anyway inconsistent with a broadly naturalistic outlook. If the necessary supervenience of colours on reflectances is false, then there will be a possible world in which the physical world is the way that it is in the actual world, but in which the chromatic world differs. To deny supervenience is therefore to deny that the way things are in the macroscopic visible worlds depends on the way things are in the microphysical world. But then what *does* the way things are in the macroscopic world depend on? In virtue of what do colours stand in the relations that they stand in the actual world to reflectances? We seem consigned to think of the laws linking colours and reflectances as arbitrarily imposed from without: it would be as if God super-added colours to reflectances in whichever way it so pleased him to at the time. Yet we do not ordinarily think that the world is contingent in this way. Things do not just vary: there is always a difference that makes the difference.

At this point, it should be stressed that although this view of the relationship between colours and reflectances is *naturalistic*, it is not in any obvious sense

physicalist. Physicalism is sometimes just defined as the acceptance of necessary supervenience: in his recent discussion of physicalism, for instance, Jackson defines as physicalist any theory that meets the ‘Entry by Entailment’ requirement, entailing the thesis that “Any world which is a minimal *physical* duplicate of our world is a duplicate *simpliciter* of our world”.⁴ This, however, is a questionable terminological decision.

In particular, it is clear that most physicalists actually have something much stronger in mind by ‘physicalism’ than mere necessary supervenience. Jackson is himself a case in point. Jackson’s unofficial statements of physicalism clearly bring out the fact that the thesis he actually wants to establish is much stronger than the necessary supervenience thesis. According to Jackson, physicalists claim to have a “*complete* story about the nature of our world”, a world that is “entirely physical in nature”; it is for this reason that according to the physicalist, the properties and relations recognised in (micro-) physical theory are sufficient to “to account for everything”.⁵ Indeed, Jackson’s version of physicalism is so strong that he even refuses to identify colours with the reflectance-types discussed in Chapter 6. Jackson identifies colours instead with the woefully heterogeneous micro-structural grounds that realise these reflectances, because he thinks that even reflectances fall outside the narrowly circumscribed physical domain.

But the Entry by Entailment requirement does not support these reductionist glosses. Insofar as the Entry by Entailment requirement is merely a supervenience thesis that states patterns of co-variation, it is consistent with the view that colours are *sui generis* properties that supervene of metaphysical necessity on reflectances. The motivation for this view, however, is precisely the thought that physical theory *cannot* tell a complete story about the nature of the material world, that the world is *not* entirely physical in nature, and therefore that the properties and relations recognised in physical theory are *not* sufficient to account for everything. The reason for rejecting reflectance-physicalism, let alone the primary quality view of colour, is that we cannot adequately account for the phenomenology of colour

⁴ Jackson 1998: 12. Similarly according to Kim, supervenience “can be viewed as defining *minimal physicalism*”, 1998: 15.

⁵ 1998: 8-9. Compare Lewis’s claim that “a supervenience thesis is, in a broad sense, reductionist”, 1983: 358.

experience without mentioning *colours*, properties that are distinct from the microphysical properties described by physicists.⁶

Generally speaking, it is difficult to find any theory of colour that isn't physicalist by Jackson's definition. Physicalism about colour is physicalist trivially. In a different way, so is the eliminativist view that colours don't exist at all. If colours do not exist, then it follows trivially that there can be no difference in an object's colour without a difference in its physical properties. Although they might not have thought about the matter in quite these terms, the British Emergentists at least didn't deny the necessary supervenience of higher-level emergent properties on lower-level physical properties. According to Broad's abstract statement of the difference between emergent and mechanistic theories, for instance, emergentism is the view the view that there are certain wholes, composed of constituents A, B, and C in a relation R to each other and that "*all* wholes composed of constituents of the same kind as A, B, and C in relations of the same kind as R have certain characteristic properties".⁷ Although this falls short of quite endorsing the *necessary* supervenience of higher-levels on lower-levels, it certainly comes close.

Even relationists typically qualify as physicalists according to Jackson's definition. Relationists deny that colours supervene locally on reflectances, as the same object can be differently coloured depending on the relation it bears to different perceiving subjects and different environmental conditions. Still, relationists at least generally accept the global supervenience thesis that according to Jackson is a necessary commitment of physicalism. It is unusual to think of relations holding irrespective of their relata. As G.E. Moore remarks:

⁶ Jackson does consider the possibility that there might be necessary connection between distinct properties, but for some reason doesn't discuss the possibility that there might be necessary 'vertical' connections, focussing instead on disjunctive properties like *having mass or being made of ectoplasm* that are mere "onlookers in the debate over physicalism". Jackson concludes from this highly selective sample base that "None of the plausible examples of necessary connections from physical properties to distinct properties that are not physical properties is an example of a connection from a physical to a [genuinely] non-physical property", 1998: 17.

⁷ Broad 1925: 61, emphasis added. In the case of the chemical compound silver-chloride, for instance, Broad is in no doubt that the "properties of silver-chloride are completely *determined* by those of silver and of chlorine". Similarly, Broad claims that the emergence of life "is perfectly compatible with the view that the characteristic behaviour of a living body is completely determined by the nature and arrangement of the chemical compounds which compose it, in the sense that any whole which is composed of such compounds in such an arrangement will show vital behaviour and that nothing else will do so", 1925: 67-8.

the fact which we express by saying that Edward VII was father of George V, obviously does not simply consist in Edward, George and the relation of fatherhood; it is further necessary that the relation should *relate* Edward to George, and not only so, but also that it should relate them in the particular way which we express by saying that Edward was father of George, and not merely in the way which we should express by saying that George was father of Edward.⁸

Relationists therefore typically attribute differences in colour to differences in the perceiving subject: what is red-for-me is not red-for-you because of some relevant difference between us. So long as the relevant experiential facts to which the relationist appeals themselves supervene on the physical facts, relationists accept that fixing all the facts in a world fixes all the colour facts; that there could not be a world in which the same object is related to the same subject and the colour differ.

If nothing else, classing as physicalist any account of colour that meets the Entry by Entailment therefore grossly devalues the physicalist brand. Presumably the point of calling a position ‘physicalist’ is to score a victory for the forward march of progress over the forces of superstition and obscurantism. Yet if by definition physicalism already occupies almost *all* of the logical space, then what progress is there to make?

Worse still, this highly ecumenical use of the term ‘physicalism’ is potentially very misleading. In trying to establish the truth of ‘physicalism’, arguments for the weak conclusion that colours supervene of metaphysical necessity on reflectances can be illicitly taken to demonstrate the much stronger conclusion that colours are ‘nothing over and above’ these reflectances, or perhaps even the heterogeneous micro-structural properties that realise them. By using ‘physicalism’ in this way, we can therefore seem to establish much more than we actually do.

Having said this, however, the naturalistic claim that colours are distinct *sui generis* properties that supervene of necessity on the reflectance properties of objects is not unproblematic. If colours are not to be an expendable species of *noblesse*, it is important to secure some – however limited – causal role for them to play. The least that this would seem to require is that colours explain the way coloured objects appear. It is, for instance, because reflectance-types are inconsistent with the thesis that colour experience simply inherits its qualitative character from that of which it is an experience that we rejected physicalist theories of colour in Chapter 6. It would therefore be a disaster if it turned out that *sui generis* colours were themselves no

⁸ 1919-20: 277-8.

better placed to satisfy the Inheritance Thesis than physical reflectance-types. Guaranteeing the causal efficacy of colour at least with respect to our experiences of colour therefore represents a non-negotiable constraint on our theory of colour.

But the necessary supervenience of colours on reflectances is generally thought to pose a problem in this respect. The domain described by physical science has a claim to completeness that other domains of scientific enquiry lack: effects described by economic theories, for example, such as stock market crashes, depressions, inflation, are often caused by phenomena that fall without the scope of economic theory, like natural disasters and wars. Physicists, in contrast, do not go beyond the properties and relations described by physical theory to find the causes of events that fall within their domain of interest. Instead, all physical effects appear to be fully determined by prior physical causes. But if the world described by physics forms a causally closed domain, then what role remains for *sui generis* properties that supervene on the physical to play? If every physical event has a fully sufficient physical cause, then there appears to be no outlet for the causal powers of supervenient properties. Supervenient properties become spare cogs in the causal process, with all the causal work being done by the lower-level properties on which they supervene. At this point, we therefore appear to face a stark choice. We seemingly either have to admit that *sui generis* colours are causally inefficacious epiphenomena, and so no better placed to respect the Inheritance Thesis than the physical reflectance properties dismissed in Chapter 6, or else deny that colours are distinct from an object's physical properties after all. Either way, our common sense conception of colour is in trouble.⁹

2. Realisation

A popular way in general of trying to secure an intelligible causal role for higher-level properties is to strengthen the relationship between higher-level properties and lower-level physical properties from mere supervenience to *realisation*.

The relationship between realisers and the properties that they realise can be modelled more or less strictly on the relationship between determinates and

⁹ Versions of the causal exclusion argument can be found in many places. Representative are Kim 1998 and Papineau 2001.

determinables. Determinates do not causally exclude the properties of which they are determinables. Rather, the causal powers associated with determinable properties are a proper subset of those associated with determinates of that determinable. Consider, for example, the relationship between the determinate property *yellow*, and the determinable *coloured*. Because being yellow is one way of being coloured, every effect that an object has in virtue of being coloured it could have in virtue of being yellow: it is therefore sufficient for something to be coloured, that it is yellow. The converse, however, is not true. There are causal powers associated with being yellow that are not associated with coloured things more generally: it is therefore not necessary that something be coloured that it be yellow. A referee's yellow card has the power to caution a football player, but lacks this power if it is any other colour.

Generalising, the same relationship is said to hold between realiser properties and the higher-level properties that they realise: namely, the causal powers associated with the realised properties are said to be a proper subset of the causal powers associated with the realiser property. Suppose, switching to the standard example, pain is identified as the property in virtue of which individuals exhibit characteristic pain behaviour, such as crying, grimacing, and so on (it will become clear later why it is dialectically important to switch examples at this point). Now suppose further that the property that realises pain is the property of being in a brain state in which your C-fibres are firing. If being in a C-fibre-firing brain state is sufficient for being in pain, then there are no effects of being in pain that are not also effects of being in a C-fibre-firing brain state. The converse, however, is not true. Being in a C-fibre-firing brain state will have effects that being pain does not: for instance producing a certain reading on a cerebroscope. Therefore, the causal powers associated with being in pain will be a proper subset of those associated with being in a C-fibre-firing brain state. Just as being yellow is *one way of being coloured*, being in a C-fibre-firing brain state will be *one way of being in pain*.¹⁰

This account promises a tidy solution to the problem of causal exclusion. On the one hand, the dependence of the higher-level on the lower-level appears to

¹⁰ According to Yablo 1992, the realiser-realised relation *just is* the determinate-determinable relation. Others mostly claim just that there is some analogy between these relations: see, for example, Clapp 2001, Shoemaker 2001, and for a similar suggestion, Kim 1998. At least two recent proponents of 'naïve' theories of colour suggest this is a way of avoiding the problem of causal exclusion: Yablo 1995 and Watkins 2003. It should also be noted that 'realisation' is sometimes just used in a general way to express a commitment to necessary supervenience.

follow from the fact that the causal powers associated with higher-level properties are a proper subset of the causal powers associated with the lower-level properties. At the same time, this account also appears to guarantee the efficacy of the higher-level properties, given that the higher-level properties are defined, at least in part, by the characteristic kinds of causal interaction into which their bearers enter.

The important question is whether the realisation response can actually deliver on both of these promises at the same time. And unfortunately, there is reason to suppose that it cannot. *Sui generis* higher-level properties either tend to be deflated entirely, or else conflated with the realiser properties from which they were supposed to be distinct.

On the one hand, there is strong pressure to simply deflate talk of the higher-level properties altogether. Consider again the example used to illustrate the approach. Although we might be happy to talk loosely about things having causal powers in virtue of being coloured, those of a parsimonious disposition will not want to take the ontological implications of this talk seriously: ‘Of course’, they will say, ‘there is a sense in which an object has causal powers in virtue of being coloured. More properly speaking, however, it seems preferable to say that it is not the determinable property *coloured* that has the causal powers at all, but the determinate properties *yellow*, *red*, and so on. The determinable *coloured* is merely an abstraction. We don’t need to suppose it really exists.’

Kim’s version of realisationism is a case in point. According to Kim, higher-level properties are best understood as ‘second-order’ properties defined by their causal role. So, if F is a higher-order property, being F is the property of having a property with a specific causal role: being dormative, for instance, the property of having a property that causes people to sleep. In the limiting case where there is only one first-order property, P, with the relevant causal profile, C, F *just is* P: the property of having the property with causal profile C is nothing over and above having the property with causal profile C. Things are slightly more complicated if there is more than one property with the same causal profile: if F is multiply realised, or multiply realisable. Although in this case straightforward property identity is out of the question, there is still a sense in which being F amounts to nothing more than being realised by whichever property, P₁...P_n, realises F: it is at least true of either P₁, or P₂, or P_n, that on that occasion, F is not anything further. For this reason,

Kim prefers to regard the predicate 'F' not as picking out a bone-fide property at all, but as functioning instead as a second-order description or designator that picks out a first-order base property.¹¹

By regarding the predicate 'F' as merely a second-order description, Kim succumbs to the temptation to simply deflate the higher-level properties that lower-level properties realise. We are no longer left with genuine higher-level properties of objects, just ways of picking out lower-level physical properties using *sui generis* vocabulary. But this is not what the realisation account promised. What we were promised were robustly existent, causally efficacious higher-level properties.¹²

To the extent to which these deflationary tendencies can be resisted, realisationism has difficulties in the other direction, respecting the fact that higher-level properties are supposed to be genuinely *distinct* from their lower-level realisers. Realisationism is effectively a version of the type-identity theory, modified in response to Putnam's multiple realisation argument. According to type-identity theorists, higher-level functionally defined properties are identical to their lower-level realisers: being in pain *just is* being in a C-fibre-firing state, being yellow *just is* having reflectance property *r*. Against type-identity theories, Putnam argued that the multiple realisation of higher-level properties rules out straightforward property identification. Realisationism appears to offer a way round this objection, without simply collapsing into Putnam's preferred solution of treating functional properties as properties that are wholly distinct from their realisers, by regarding realiser properties as in some sense *constituting* the properties that they realise.¹³

Insofar as realisationism is just a version of an identity theory, any temptation to deflate talk of higher-level properties is misplaced. According to

¹¹ 1998: 98-106.

¹² The realisation view is also sometimes claimed to effectively assimilate the relationship between realisers and the properties they realise to the relationship between parts and wholes, in the sense that the causal powers associated with lower-level properties *constitute* the causal powers associated with higher-level properties (e.g. Shoemaker 2001: 80). Leaving to one side worries that we might have about the sense of making constitution claims in relation to properties, the same deflationary problem arises. Although we are certainly happy to talk of parts independently of the wholes of which they are parts, those of parsimonious disposition will be reluctant to take this talk seriously. So, for instance, whilst there is a sense in which it is my hands that are writing these words, I do not expect my hands to take the credit or disapprobation for what has been written. It is not *really* my hands, but only my hands *qua* part of the whole that they compose (i.e. *me*) that deserves the credit or blame.

¹³ Putnam 1975. This is especially clear in Clapp's version of realisation, which type-identifies higher-level properties with disjunctive properties, exhaustively constituted by the properties named by the different disjuncts. It should be noted that Kim is not unaware of this possibility, but chooses to reject it because of qualms about disjunctive properties: Clapp's exposition of realisationism takes the form of rebuttals to Kim's objections to the legitimacy of disjunctive properties.

Leibniz's Law, if x and y are identical then anything that is true of x is also true of y . In the limiting case in which there is just one realiser property, for instance, it follows that whatever is true of the realiser is also true of the property that it realises. In particular, if the realiser is associated with causal profile C , the property that is realised is also associated with the same causal profile. Therefore, the realised property is causally efficacious just in case the realiser property is.

This is fine as far as it goes. However, it does not go far enough. The deflationary temptation to which Kim succumbs is symptomatic of a fundamental problem with realisationism understood in this way. At least part of the reason why it is tempting to deflate higher-level properties is that even in this modified form, the type-identity view does not secure the causal efficacy of higher-level properties *in the right way*: in the end, it may therefore seem better just to sweep these properties under the carpet. The problem with realisationism is that it attributes the wrong causal powers to the wrong properties. Consider the determinate-determinable analogy with reference to which realisationism is first introduced. Explicating the higher-level/lower-level relation with reference to the relationship between the determinable *colour* and the determinates *yellow*, *red*, etc. makes the realisationist view seem less reductive than it really is. The strictly analogous relationship to being coloured and being yellow in the case of pain, however, is not between being in pain and being in a C-fibre-firing mental state, but between being in pain and being in a pain state with a specific qualitative character: for instance, having a sharp stabbing pain, or a dull ache. Just as irreducible colour vocabulary does not drop out when we move from the level of determinables to determinates in the case of colour, for the sake of parity irreducible pain vocabulary should not drop out in the move from determinables to determinates in the pain case either.

If realisationism is true, then being yellow and being coloured cannot itself serve as model for the relationship between realiser and realised, because *yellow*, *red* etc will themselves be susceptible to reductive analysis. Yellowness, for example, will be realised by an indefinite number of token reflectance properties which together constitute an anthropocentrically defined reflectance-type. The causal powers that something has in virtue of being yellow will therefore be a subset of the causal powers that something has in virtue of having a certain reflectance property. The idea that the causal powers associated with colours could be a subset of the causal

powers associated with reflectance properties, however, is precisely what led us to reject physicalism about colour in the first place. Amongst the causal powers associated with the reflectance property on this view would be the power to produce qualitatively different visual experiences in subjects with different visual apparatus. But how one and the same property (or set of properties) *could* produce qualitatively different veridical experiences in different subjects is precisely what we found to be mysterious. Consistent with the thesis that visual experiences simply *inherit* their qualitative character from that of which they are experiences, it would require reflectance-types to have multiple qualitative characters. And this is inconsistent with a sufficiently robust understanding of qualitative character (§6.5).

To say that the causal powers associated with a realised property are a proper subset of those associated with the property that realises it presupposes that realiser and realised property could have the very same causal powers. But this does not respect the motivation for saying that colours and reflectances are distinct properties in the first place. The initial reason for postulating *sui generis* colours was the thought that physical reflectances *cannot*, consistent with the Inheritance Thesis, causally explain our colour experiences. What we need are properties with causal powers that differ *in kind* to the causal powers associated with the properties on which they supervene. Colours, that is, need causal powers of their own.

3. The Causal Efficacy of Colour

Enshrining the right of colours to novel causal powers raises with renewed vigour the causal exclusion argument. On the one hand, the physical domain appears to be complete in a way that other areas of scientific endeavour are not: it seems, that is, that *every physical event has a purely physical cause*. At the same time, we want to hold onto the idea that *sui generis* properties can have causal effects, and, at least on the face of it, physical effects at that. But barring the causal overdetermination of these events by independent physical and *sui generis* causes, there doesn't appear to be any causal work for the supervenient *sui generis* properties left to do. If every physical event has a purely physical cause, then there are no gaps in the causal process for the supervenient properties to fill. And now it seems that in order to avoid becoming

causal epiphenomena, colours have to be identified with physical properties after all. But is this right?

In the first place, there is a problem about exactly what is meant by saying that ‘the physical domain is causally complete’. Clearly, the causal exclusion argument can only get going if we exclude from the physical domain *sui generis* properties like colour: if, in contrast, these properties themselves form part of the physical world, then there is no inconsistency in the joint assumptions that the physical domain is causally closed and that *sui generis* properties have physical effects. There are, however, well documented difficulties associated with the project of trying to give a non-trivial definition of ‘physical’ that includes everything the physicalist wants to include and excludes everything they want to exclude.

Purely *a priori* constraints on what counts as physical, for instance, typically fail to exclude *sui generis* colours from the physical domain. Snowdon, for example, suggests that physics can be identified as the discipline which aims to describe the most basic features of the things (tables, chairs etc) that we encounter in perception. But of itself – at least without a better understanding of ‘basic’ – this does not rule out the possibility that colours are amongst the things that an account of the basic features of the objects that we encounter in perception must describe. The objects that I encounter in perception certainly appear coloured, and this is a much more basic feature of them than many things that I could care to mention: for instance, where and by whom they were made, whether I like them or not, and so on.¹⁴

A posteriori definitions of ‘physical’, on the other hand, run the risk of falsifying the crucial assumption that physics is complete. If ‘physical’ is understood in terms of what people in physics departments actually study, then it is almost certainly false that the physical domain is complete. It was once thought that the smallest entities were atoms. Then sub-atomic particles like electrons and protons were discovered. Eventually quantum mechanics was introduced to explain atomic phenomena, and more recently string theory has been developed in an attempt to explain quantum phenomena. It would be foolish to bet against the possibility that one day something yet more remote from our understanding will be introduced to

¹⁴ 1989: 153. Snowdon himself acknowledges that these *a priori* constraints do not get us any closer to determining precisely what the content of ‘physical’ is.

explain string theory. If so, then the completeness of physics, understood with reference to the content of current physical theory, is false.

In light of these problems, it is sometimes suggested that it is not so important that we know what ‘physical theory’ *includes*, only that we know what ‘physical theory’ *excludes*. According to Papineau, for instance, whose concern is with the causal efficacy of the mental:

provided we can be confident that the “physical” in this sense is complete, that is, that every nonmental effect is fully determined by *nonmental* antecedents (in the sense of antecedents that *can* be identified without using mental categories), then we can conclude that all mental states must be identical with something nonmental (otherwise mental states couldn’t have nonmental effects).¹⁵

We can well imagine someone making an analogous remark with respect to colour. Indeed most physicalists would probably be prepared to say the same of chemical and biological properties: in discussing the problem of causal exclusion most physicalists are more or less explicit that ‘physical’ is not just to be read as ‘nonmental’, but as ‘microphysical’. The rationale for this is that whatever gaps current physical theory may contain, it seems improbable that high-level properties like *sui generis* colours will be needed to plug them. These gaps will be filled instead by properties of ever smaller entities.

Even so construed, however, it is not clear that the completeness of physics is true. The first thing to note is that the existence of *sui generis* colours with novel causal powers does not directly threaten the completeness of physics in the same way that the existence of *sui generis* mental properties does. Colours lack the wide cosmological role of mental states. They are not themselves plausibly thought of as affecting the purely physical properties of objects. Colours, for instance, play no role in the workings of the underlying mechanisms of colour perception. We do not suppose that they exert a causal influence on the sensory organs in the way required, for instance, by Scholastic theories of perception: the retinal receptors do not ‘receive’ colours, transmitting their form into the mind for inspection. The proximal stimuli of the perceptual process is not colour as such, but electromagnetic light: facts about colour are recovered by the perceptual system from the information encoded in this light, given certain anchoring heuristics. Given that there is no

¹⁵ 2001: 12. Compare Jackson 1998: 7.

presumption that colours exert a direct causal influence over the physical, colours pose no direct threat to the completeness of physics. That is, colours are not themselves plausibly thought of as exerting any direct *downwards causal* influence.

The causal exclusion problem for colour instead piggybacks on the causal exclusion problem for the mental. The causal powers associated with being coloured make ineliminable reference to the mental states of perceiving subjects. Problems about causal exclusion therefore arise in relation to colours only insofar as the effects of colour on perceiving subjects have an impact upon events in the purely physical world. Consider, for example, an artist mixing paints on her palette. Her paint sample is too light to capture the foreboding rain clouds gathering overhead, so she moves her arm in order to mix in a darker colour. The colour of the original paint sample thereby indirectly brings about a chain of seemingly physical events.

But does even this violate the causal completeness of physics? On broadly Moorean grounds, for instance, we are surely more confident that the mental is causally efficacious than we are of the truth of any metaphysical principle that might be adduced to argue for a non-trivial claim about mental efficacy: either that the causal efficacy of the mental is secured only by the identity of mental and physical, or perhaps even that the mental is not efficacious at all. For instance, it is not just obvious that we *could* tell a complete causal story without reference to mental events and properties. Any account of the paint mixing episode that omitted reference to the artist's experience of the paint, subsequent desire for the paint to appear darker and beliefs about how to achieve this, would seem to be essentially incomplete. Counterfactually speaking, for example, it seems false to say that if she *hadn't* had the experience, consequent desire and relevant background beliefs, the paint mixing would have occurred anyway. Paint does not mix itself. The experience, belief and desire set at least appear to make some difference to the subsequent course of events.¹⁶

So far, this is to do little more than maintain (banging our fist at the same time) that the mental *does* exert a causal influence. Clearly, leaving the matter here would be unsatisfactory. As Burge points out, the challenge of causal exclusion is best seen, not so much as an attempt to convince us that the mental is *not* causally efficacious, as to prompt us to give an account of *how* it exerts a causal influence.

¹⁶ For a similar 'Moorean' argument, see Burge 1993.

Nothing that has yet been said goes any way towards meeting this further requirement.

To this end, it will therefore help to look in more detail at exactly what the problem of causal exclusion is supposed to be. Why should it be problematic that, for instance, my decision to move my arm *ceteris paribus* has the effect of my arm moving? The first thing to stress is that the causal exclusion problem does not turn on any distinctive features of particular *sui generis* properties. When Descartes claimed that *sui generis* colours could not play any intelligible part in the perceptual process, for instance, this is because he thought there are substantial *a priori* constraints on which properties can stand in genuine causal relations. The mechanistic *causal likeness principles* require effects to be proportional to their causes. Because colours are non-essential properties of material substance – we have seen, and can imagine seeing, objects that are so pellucid as to lack colour – colours cannot be thought to produce changes in the essential properties of matter, as they would have to if they impinged on our sensory organs: this would be a case of something less perfect producing an alteration in something more perfect (§1.1).

But it is not any assumption about the heterogeneity of mental and physical, coupled with *a priori* constraints on what counts as intelligible causal explanation, that is the source of the causal exclusion problem. So, for instance, there is nothing problematic from the perspective of causal exclusion about arm movements as such. Indeed, it seems entirely natural to suppose that *my* decision to move a part of *me* should cause a part of *me* to move. Intuitively cause and effect – my decision and my arm – are both on the same level: they are both properties of a macroscopic entity, namely *me*.

This may be obscured by the fact that arm movements are at least in some sense ‘physical’ events. But is important to bear in mind that they are not ‘physical’ events in the sense relevant to the causal exclusion argument: they are not, for instance, ‘physical’ in the negative sense given to this term above. If we are confident that every physical effect is fully determined by antecedent causes that can be identified without using mental categories, then we are no less likely to think that every physical effect is fully determined by antecedent causes that can be identified using no macroscopic categories at all. Arms, macroscopic bodies in general, even

chemical and biological properties, have no more place in physical theory than minds and colours.¹⁷

Rather, the causal exclusion problem arises when we suppose that supervenient properties at higher-levels exert a causal influence on lower-level properties; canonically when the higher-level properties are properties of *macroscopic* objects and the lower-level properties are properties of entities at the *microscopic* level. For instance, when Papineau asks us to imagine that the completeness of physics might be false, he asks us to suppose that “some physical effects (the movements of arms, perhaps, or the firing of the motor neurons that instigate those movements) were not determined by law by prior physical causes at all”.¹⁸ Clearly what Papineau is worried about are not *sui generis* mental properties causing the movement of arms as such, but *sui generis* mental properties – properties of macroscopic entities like persons – exerting a causal influence over the microscopic motor neurons that scientific theory tells us “instigate” (cause?) those arm movements.

A commitment to downwards causation is often thought to be a defining feature of views which assign higher-level properties causal powers that differ in kind to the causal powers associated with the microscopic properties on which they supervene: McLaughlin, for instance, even suggests that it was precisely this commitment to downwards causation that ultimately brought about the downfall of British Emergentism.¹⁹ It is certainly an impression that proponents of this view often do little to discourage. The British Emergentist C.L. Morgan, for instance, appears to state a commitment to downwards causation when he says that:

when some new kind of relatedness is supervenient (say at the level of life), the way in which the physical events which are involved run their course is different in virtue of its presence – different from what it would have been if life had been absent.²⁰

¹⁷ Compare Sturgeon’s objection (1998) that the causal exclusion argument equivocates on the word ‘physical’: in saying that physics is complete, ‘physical’ is meant in the sense of quantum physical, whereas in saying that the mental has physical effects ‘physical’ is used in a much looser way, akin just to ‘macroscopic’.

¹⁸ Papineau 2001: 8-9.

¹⁹ McLaughlin 1992. According to Kim (1998: 42), the only way to reconcile the causal efficacy of mental property M with respect to mental property M* and the supervenience of M* on physical property P*, is by accepting that M causes M* by causing P*. Crane 2001 also claims that downwards causation is essential to emergentism, and argues that the same is true of so-called ‘nonreductive physicalism’ more generally.

²⁰ Morgan 1923: 16.

It would, however, be odd if a commitment to downwards causation really were a consequence of the view that there are *sui generis* properties with novel causal powers. Admitting into your ontology *sui generis* properties that supervene on physical properties is effectively to deny the occurrence of *upwards causation*. No small part of the motivation for saying that there are *sui generis* properties with novel causal powers is the belief that the underlying physical properties are the wrong kind of properties to do the relevant causal work: in the case of colour, for example, the reason for saying that colours are *sui generis* properties is that the physical reflectances on which colours supervene cannot, consistent with the thesis that experiences inherit their qualitative character from the properties that they are experiences of, cause our colour experiences. Similarly for arm movements. Papineau describes the firing of motor neurons as ‘instigating’ arm movements. But if by this he means that the firing of motor neurons *causes* arm movements, then it is something that the emergentist should want to reject. Taking seriously talk of levels of nature, microscopic motor neurons cannot *cause* changes in macroscopic objects like arms. Motor neurons may be able to cause changes in other entities of the same level – the microscopic entities that compose my arm. But this, according to the emergentist, is not the same thing as saying that they thereby cause changes at the macroscopic level. To suppose that they have macroscopic effects is to assume that arms are identical with the lower-level entities that constitute them. But this is precisely what is denied in saying that *sui generis* properties with novel causal powers emerge at higher-levels of functional organisation.

To suppose now that there could be downwards causation in the absence of upwards causation, however, gives the higher-level an unfair privilege over the lower-level. If physical properties cannot causally affect *sui generis* supervenient properties then it hardly seems fair that these properties should enjoy this influence in the other direction. My decision to move my arm shouldn’t be able to cause the low-level entities – molecules, atoms, or whatever – that compose my arm to move any more than the firing of motor neurons can cause my (macroscopic) arm to move. The only way it could would be if my arm and the lower-level entities that compose my arm were identical. Yet it follows from the claim that my arm can have properties that differ in kind to properties of the entities that compose my arm that the two are *not* identical.

Of course it is true that when I decide to move my arm and execute this decision successfully there is movement in the microscopic entities that compose my arm. But this not to say that my decision *causes* the microscopic constituents of my arm to move. If it were, then to avoid playing favourites we should have to say that an object's affecting the incident electromagnetic light *causes* my subsequent colour experience. But this is precisely what we denied in claiming that colours are *sui generis* properties. In the case of colour, an object's reflectance causes a change in the incident light. This in turn causes certain changes in our retinal receptors and processing mechanisms. But the object's reflectance does not thereby *cause* the colour experience. Indeed, it is unusual even to say that the *neural processing* causes the relevant experience. The relationship between subvenient and supervenient is not naturally thought of in causal terms at all: for one thing, subvenient and supervenient occur simultaneously, whereas causation is more usually thought of as a temporal relation in which causes precede their effects. The cause of the experience is therefore neither the reflectance nor the neural processing, but the *sui generis* colour that is non-causally determined by the reflectance. The lower-level non-causally determines the higher-level properties and it is the higher-level properties that then do the causal work.

The same applies in the opposite direction. My decision to move my arm is non-causally related to a property of the microscopic entities that constitute my brain, whilst my arm is non-causally related to the microscopic entities that compose my arm. My decision to move my arm causally affects my arm, but not the microphysical entities to which my arm is non-causally related. What causes the change in the lower-level entities that compose my arm are prior changes in entities of the same level, entities on which my *sui generis* mental state supervenes.²¹

We can put the same point in more general terms by focussing on the worry that distinguishing the physical from the supervenient leads to widespread 'overdetermination'. The widespread overdetermination of effects is typically considered to be at best improbable and at worst absurd. To start with, we are told to think of classic cases of causal overdetermination, as when a person is

²¹ In effect, what the emergentist denies is therefore that causation transmits across non-causal relations. If C causes E and E constitutes (or is in some other way non-causally related) to E*, then it does not follow that C causes E*. This, it seems, is just a commitment of the view that there are different properties at different levels of functional organisation, and that at least in part what this difference consists in is a difference in causal powers. See Sturgeon 1998.

simultaneously shot by two bullets. In this case, the same event – the person’s death – has two fully sufficient causes: had either cause not been absent, the event would still have occurred. We are then told that something like this must be occurring all the same if properties in addition to the purely physical properties exert a causal influence.

No doubt part of the reason why the causal exclusion argument appears convincing is that it is implausible to suppose that *this* kind of overdetermination occurs anything other than infrequently. But the example only works because it is wholly misleading. The death of the person who is simultaneously shot twice is *causally* overdetermined. Given that the aim of the argument is to show that *sui generis* properties are *causally* excluded, it is important that we think of their effects as also causally overdetermined. But this was never the suggestion. According to the emergentist view, arm movements, for instance, are not *causally* overdetermined by mental and physical properties. Arm movements are doubly determined, but they are not thereby *overdetermined*, because the determination on the part of the physical is non-causal. There is exactly as much determination as there needs to be, given that *ex hypothesi*, *sui generis* properties with novel causal powers are supposed to supervene with metaphysical necessity (i.e. non-causally) on physical properties.

Another way of making essentially the same point is that the causal contexts in which we are interested are not causal contexts in which there is in fact just one event, as there clearly is in the case where someone’s death is causally overdetermined by two bullets. Arm movements are not, according to this way of thinking, purely physical events. Arm movements are complex events that have higher- and lower-level aspects. On the macroscopic level there is the moving of part of an agent’s body. On the microscopic level, there is the moving of the molecules that compose an arm, the moving of the atoms that compose the molecules that compose an arm, and so on. The conclusion that *sui generis* mental properties are causally inefficacious only follows if we assume that the different aspects of this event are identical. But this is just what we deny when we admit into our ontology *sui generis* properties at different levels of functional organisation in the first place.

4. Levels of Nature

In securing the causal efficacy of colour, a lot of weight has been placed on the idea that there are distinct levels of functional organisation at which properties with novel causal powers emerge. More therefore needs to be said about this.

It is, for instance, resistance to the idea of *sui generis* properties with novel causal powers – causal powers different in kind to the powers associated with properties of lower-level physical entities – that lies at the heart of the original arguments offered by mechanists like Descartes and Locke for the secondary quality status of colour (§§1.1-2). When Descartes complains that sensory experience fails to yield a clear and distinct conception of colour, at least part of the problem lies in his failure to understand how the essential properties of matter – size, shape and motion – can produce something else whose nature is quite different from their own. Locke’s distinction between primary and secondary qualities, as we have seen, is drawn on the same grounds, although he more explicitly expresses these worries in relation to the ‘thinking matter hypothesis’, the thesis that thinking substance is just “*some certain System of Matter* duly put together”. To suppose that thought is a property of material substance that emerges when substances reach a certain level of functional complexity is, Locke maintains, absurd:

unthinking Particles of Matter, however put together, can have nothing thereby added to them, but a new relation of Position, which ‘tis impossible should give thought and knowledge to them.²²

The possibility of macroscopic objects instantiating properties that differ in kind to the properties of the matter of which they are composed is foreclosed in corpuscularian science by the assumption of the ‘catholick’ nature of matter: that the determinable qualities of matter are all, and everywhere, the same. This assumption provides a way of forging the most direct possible tie between the macroscopic observable world and the microscopic unobservable world. The insensible corpuscles in virtue of which corpuscularianism explains all natural phenomena instantiate determinates of exactly the same determinable properties as the macroscopic objects that we perceive in everyday life. Tying the unobservable realm

²² 1690: IV.x.16.

to the sensible in this way sweetens the pill of admitting into your ontology objects that have not been seen, and perhaps never will be seen. There is no mystery about what these extended, possibly solid, mobile corpuscles are: they are just like billiard balls, tennis balls and cannon balls, only on a much smaller scale. As Descartes assures those who are worried about the postulation of particles that cannot be perceived by the senses:

No one who uses his reason will, I think, deny the advantage of using what happens in large bodies, as perceived by our senses, as a model for our ideas about what happens in tiny bodies which elude our senses merely because of their small size. This is much better than explaining matters by inventing all sorts of strange objects which have no resemblance to what is perceived by the senses.²³

One of the morals to draw from the breakdown of mechanistic science in writers like Locke is that this macro-micro model of explanation is unduly restrictive. As Newton's *Principia* brought home, an empirically adequate science cannot be bound by substantial *a priori* explanatory constraints: it cannot be decided in advance what form intelligible explanation must take. Modern scientists therefore have no compunction about "inventing all sorts of strange objects which have no resemblance to what is perceived by the senses" in order to explain macroscopic phenomena. On the one hand, the catholick qualities of macroscopic entities identified by the corpuscularians as essential to material substance no longer go all the way down. Quarks, superstrings and singularities, for instance, have no obvious shape or size. Point masses are not extended. Gravitational fields are not solid. Unobserved quantum particles may even lack determinate spatio-temporal location. Instead, the microscopic world abounds with entities that have properties lacking from the macroscopic realm. The spin, charm and flavour of quarks, for example, are mere homonyms of the properties that we ascribe to macroscopic objects.

But if it does not contravene the practices of modern science to postulate properties that differ in kind at different levels of functional organisation, why should there be a special problem in the case of colour? Clearly most philosophers think that there *is* a special problem with respect to colour, otherwise physicalists wouldn't identify colours with reflectances, and relationists and eliminativists

²³ 1644: IV.201.

wouldn't think it necessary to eliminate *sui generis* mind-independent colours from the material world altogether. But why?²⁴

The problem is that in resisting the causal exclusion argument we presuppose the existence of metaphysically necessary non-causal relations between supervenient properties and the physical properties on which they supervene, relations whose obtaining cannot be explained in any other terms. The law between colours and the reflectances on which they supervene will, as Broad puts it, be “*unique and ultimate*”.²⁵ This commitment to metaphysically basic ‘vertical’ laws linking properties at different levels on the macro-micro hierarchy is widely thought to be wholly implausible. Horgan, for instance, thinks that we need to eschew supervenience in favour of ‘superdupervenience’ if we are to avoid the ignominy of admitting these ‘unexplained explainers’ into our ontology: any metaphysically basic facts or laws must be facts or laws within physics itself, and preferably fundamental physics at that.²⁶ In a similar vein, Tye protests against vertical laws linking colours and reflectances that “surely it *cannot* just be a brute fact that they obtain in the range of possible worlds that they do. Surely there must be some explanation”.²⁷

But is the situation really that bad? On the one hand, we can go at least some way towards closing the gap between colours and reflectances by thinking about colours in terms of their wider causal context. Generally speaking, low-level explanations of high-level phenomena are never successful in isolation, but always need to take into account the causal nexus of which a property is a part. The explanation of temperature in gases in terms of the mean molecular kinetic energy of the molecules that compose the gas, for instance, depends upon taking into account the relationship of temperature to pressure and volume in the thermodynamic theory of gases. We cannot hope to just explain gas temperature in low-level terms, but have to simultaneously explain the whole macroscopic causal network that the thermodynamic theory describes.

If we similarly take into account facts about the perceiving subjects and their visual systems that lie at the heart of the causal network of which colours are a part,

²⁴ Even eliminativists and relationists who offer other grounds for their views generally throw in for good measure the consideration that colours have no place within our best physical theory: see, for instance, Cook Wilson 1904: §526, McDowell 1985: 112, Johnston 1992: 139.

²⁵ Broad 1925: 65.

²⁶ Horgan 1993.

²⁷ Tye 2000: 149.

continuities between the different levels soon start to appear. Facts about the physical realisation of the perceptual system, for instance, explain a host of facts about the precise form the consequent colour experience takes. We experience washing out when we stare at a colour for a prolonged period of time, for instance, because the retinal receptors become desensitised to light that is constantly present. Hue discrimination varies with brightness – the *Bezold-Brücke effect* – because the yellow-blue psychophysical channel is less sensitive than the red-green channel at low illumination levels. And so on.

More generally, we can use the colour experiences of normal subjects to determine *a posteriori* the physical correlates of colour, using knowledge of the way the visual system functions to determine of any given reflectance what colour an object with that property will instantiate. For instance, we can predict that objects which reflect a relatively high proportion of the incident light throughout the visible spectrum generally look white; objects that tend to reflect more light in the middle of the visible spectrum than in the long-wavelength part, and roughly the same amount of light in the short-wavelength part as in the middle and long-wavelength combined, look green; and so on. Indeed, combining generalisations of this kind with knowledge of the physical constitution of light, we can further determine the results of a body's interaction with different kinds of light, predicting what colour objects will appear under different illuminations, as, in effect, we did in Chapter 3. It is this possibility of pairing colours and reflectances that colour physicalists exploit in trying to identify colours with physical properties. Their problem is that this procedure does not yield the requisite property identities. Colours have attributes that reflectances lack: there is no analogue of the distinction between unique and binary hues, or between elemental and binary colours more generally, at the level of reflectances; reflectances do not stand in the internal relations of similarity and difference characteristic of the colours; and so on.

Even though there remains this gulf between colours and reflectances, however, this still does not mean that colours are any worse off than other paradigmatically physical properties. For instance, it is often claimed that a distinctive feature of higher-level *sui generis* properties is that their occurrence cannot be predicted in advance from knowledge of the properties of the parts of which the whole is composed. As Broad remarks in relation to smell:

a mathematical archangel, gifted with the further power of perceiving the microscopic structure of atoms as easily as we can perceive haystacks...would be totally unable to predict that a substance with this structure [containing three atoms of Hydrogen to one of Nitrogen] must smell as ammonia does when it gets into the human nose...he could not possibly know that these changes would be accompanied by the appearance of a smell in general or of the peculiar smell of ammonia in particular, unless someone told him so or he had smelled it for himself.²⁸

But in the brave new world of modern science, ‘predictability in advance’ does not serve to distinguish colour from any other higher-level physical phenomenon. It is a quite general point that being able to predict the occurrence of a higher-level phenomenon on the basis of a lower-level phenomenon requires that we have the vocabulary to describe the higher-level phenomenon. We cannot predict an event described using high-level vocabulary in terms of an event described in the vocabulary of lower-level processes without having some way of translating one vocabulary into the other; all that we can predict using low-level vocabulary are further events described using the same vocabulary. Any putative case in which a low-level explanation is offered of a high-level phenomena therefore requires Nagelian ‘bridge laws’ linking the vocabulary of the two theories: we need to know that the explanation of a phenomenon described using low-level vocabulary is *eo ipso* a description of the same phenomenon identified using high-level vocabulary. In this sense, *no* higher-level event can ever be predicted solely on the basis of a low-level theory.²⁹

There may at least seem to be this difference between colours and other physical properties. In the case of colour I’ve argued that the vocabulary linked via bridge laws refers to distinct, though necessary co-extensive, properties. In other areas of scientific endeavour, however, the referents of terms linked by bridge laws are more usually thought to be identical. So, for instance, it is typically claimed that temperature in gases *just is* mean molecular kinetic energy, water *just is* H₂O. But this too fails to withstand critical scrutiny.

First, it is important to stress that ‘smooth reductions’ of this kind are actually few and far between. It is rare to find higher-level properties that correspond so neatly with properties at a lower-level. Just consider the properties

²⁸ Broad 1925: 71-2.

²⁹ Crane 2001: 215.

that represent the physicalist's best hope of finding a property with which to identify colours: surface reflectance properties, and light-affecting properties more generally. The phenomenon of metamerism means that there is no single reflectance property with which colours can be identified. Any given colour can be realised by an indefinite number of reflectances. It is for this reason that physicalists themselves typically identify colours with reflectance-types: a collection of otherwise heterogeneous light-affecting properties that have in common just the fact that they are the correlates of perceived colour. The same is no less true of light-affecting properties and their microstructural grounds. There are many different ways in which any given way of affecting the light can itself be realised. Indeed, Nassau famously identifies no less than fifteen standard microphysical 'causes of colour'.³⁰

Even in the best case scenario where there is a strict correlation between the vocabulary of different theories, however, it still does not follow that we have anything more than necessary correlations between distinct properties. Consider a paradigmatically successful example of micro-explanation: water is H₂O. If we're already sceptical about whether properties of macroscopic phenomena can ever be identified with lower-level physical properties, then it manifestly begs the question to be told that they can, because, for instance, water *just is* H₂O. If we are worried that facts about molecular bonding cannot explain the occurrence of macroscopic properties in general, then they cannot explain why water has the specific *phenomenal* properties of being tasteless, odourless, colourless and so on. 'Water' may yet rigidly designate that macroscopic stuff that is composed of two hydrogen atoms bound to one oxygen atom. But it does not follow that water is thereby *identical* with H₂O: that water is 'nothing over and above' H₂O. This is a further, reductive step, the legitimacy of which is precisely what is in question.

Note that in saying this we are in no sense contradicting physical theory, either. It is not part of *physics* that wholes are 'nothing over and above' their parts. As Mackie ruefully observes, denying the existence of properties over which physical theory does not quantify "is a further, philosophical, step", usually taken on grounds of ontological parsimony.³¹ But considerations of ontological parsimony cut no ice

³⁰ Nassau 1983, Hardin 1988: 1-7.

³¹ 1976: 19. Similarly according to Jackson to suppose that temperature in gases is distinct from, but necessarily correlated with, mean molecular kinetic energy "would be to embrace...an ontologically extravagant option", 1998: 58.

against the emergentist view that wholes have properties that their parts lack. The reason for thinking that wholes have properties that their parts lack is that properties of the lower-level constituents are incapable of explaining the causal interactions of the whole. It is not ontologically extravagant to postulate the existence of properties that fulfil an indispensable explanatory function.

In saying this we might just seem to be compounding mystery with mystery: far from explaining why colours supervene of metaphysical necessity on reflectances, we have just made every other inter-level relationship in the natural world equally mysterious. But this does not follow either. The necessary supervenience of colours on reflectances is not unexplanatory. Saying that colours are *sui generis* properties with novel causal powers that supervene of metaphysical necessity on a object's reflectance *just is* to explain why objects instantiate the colours that they do. It is to say that objects appear they way they do *because* they instantiate properties that supervene of metaphysical necessity on their physical properties. For some, this will not be explanation enough. But then why suppose that any further explanation of the higher-level facts than this *must* be possible?

The only reason for requiring a more demanding explanation appears to be a prior conviction that the microscopic world described by physical theory is all that there is. The only further explanation of these facts that would seem to be even theoretically possible is one that says that higher-level phenomena are really just one and the same as the lower-level phenomena described in physical theory: as Kim remarks, "Identity takes away the logical space in which explanatory questions can be formulated".³² But if in the end this is all the demand for further explanation amounts to, then it is simply unreasonable. If the only reason to think there are no metaphysically basic vertical laws is a prior commitment to the view that everything is physical, then this can hardly function as a premiss in the argument for the conclusion that everything *is* physical. Perhaps the necessary supervenience of colours on reflectances is just something that, to use Samuel Alexander's phrase, we need to accept with "natural piety".³³

³² Kim 1998: 98.

³³ 1920 ii: 47.

5. Conclusion

Descartes claimed that when someone says they see a colour this amounts to saying that they see something of whose nature they are wholly ignorant. Like countless others since, Descartes thought that the mind-independence of colour cannot be squared with the way we have reason to believe the world is independent of our experience. The conception of colour that we form on the basis of this experience is therefore neither clear nor distinct: on the basis of visual experience we know neither what colours are, nor how they are related to the other properties of material objects.

This is usually presented just as the logical conclusion that any right thinking naturalist should draw. But in fact it is itself far from naturalistic. The Cartesian paradigm sets more store by *a priori* principles about the way the world must be than by the testimony of our natural mode of cognitive access to the world: sense perception. In calling this basic cognitive faculty into question, which phenomena must be further explicable is demarcated in advance: it is assumed on *a priori* grounds, for instance, that there will in fact be just a limited number of privileged properties that are fully sufficient to ‘account for everything’. But this assumption is not itself part of physical theory, and runs contrary to the methodology that many scientists – especially those working in the so-called special sciences – themselves employ. Scientists investigating higher-level phenomena generally prefer the vocabulary of their chosen discipline. They do not frame the laws governing higher-level phenomena in the language of base level physics, but do so wherever possible in the language proper to that domain of enquiry. It is difficult to understand why they should do this if the world really consisted just of the properties over which a narrowly circumscribed physical theory quantifies. If a limited number of properties really are sufficient to ‘account for everything’, why is it that scientists investigating higher-level phenomena do not themselves account for higher-level phenomena in these terms?

The natural explanation of why scientists investigating phenomena at higher-levels of nature work in the vocabulary of their chosen discipline is that there are distinct phenomena at these levels that constitute the subject matter of those disciplines. These properties cannot be adequately understood in any other terms

because the underlying lower-level properties themselves lack the relevant attributes: in trying to understand these properties in terms of any other properties, salient features of the properties under consideration are therefore inevitably lost. Colour is a prime example. In claiming that colours are properties of whose nature we are ultimately ignorant, physicalists deny the existence of a phenomenon that forms the distinctive subject matter of legitimate and informative kinds of empirical investigation.

On the one hand, there are robust laws of colour appearance that we can only frame using exclusively chromatic vocabulary. Grassman's Third Law of colour mixture, which is the basis of modern colorimetry, for example, states an invariant relationship between the hue and saturation of chromatic lights that is independent of the way in which these lights are physically realised. According to Grassman's Third Law, any two coloured lights of identical hue and saturation appear identical in colour when they are mixed with any other light, and this is so regardless of their spectral composition. The salient features of the lights are not their physical characteristics, but their *colours*.³⁴

The phenomenon of metamerism means that it is slightly more difficult to frame robust chromatic laws governing the way light interacts with material objects, as objects that appear identical in colour under one illumination can appear different in colour under another illumination. But there are still at least some general relationships that we can describe. As we saw in Chapter 3, the interactions of achromatic objects with different kinds of light are largely invariant. White objects, for example, reflect light of any spectral colour equally and in good measure. As such, white objects assume the colour of the light with which they are illuminated: they look blue under blue light, red-orange in candle light, and so on.

The way in which chromatically coloured objects interact with the light is more complicated. But at least approximate generalisations are possible even here. One fairly safe generalisation, for instance, is that although they might not reflect light from their own part of the visible spectrum most copiously, chromatically coloured objects at least reflect light of their own colour well (§3.3, §6.3). More generally, robust object-illuminant relationships can be discovered if we at least stick

³⁴ The discussion at this point draws in a number of places on Westphal 1987: 70-6 and Broackes 1992: 194-202.

to the level of determinable colour: the properties that phenomenological, psychological and linguistic investigation suggests actually has cognitive significance for us (§5.3). Because of the problem of metamerism, Chevreul's observation that, for instance, "Violet rays falling upon a Yellow stuff, make it appear Brown with an excessively pale tint of Red", may not be universally true. But less specifically, at least illuminating a yellow object with a violet light will make it look to be some determinate of the determinable brown.³⁵

Similarly robust laws using unapologetically chromatic vocabulary can be framed with respect to the affect on perceived colour of successive and simultaneous contrast. We know from examples like that represented in Figure 3.1 that the background against which the achromatic colours are perceived greatly affects their perceived colour. Greys, for instance, appear lighter or darker as the background against which they are perceived is darker or lighter. Although less pronounced, similar effects occur with respect to the chromatic colours. Again, these effects conform to laws, described in detail by amongst others Goethe and Chevreul. Colours are more pronounced when seen against the background of their *complementary colour*: for monochromatic coloured lights, the colour that light it would need to mixed with to produce an achromatic stimulus. The yellow cross of the Swedish flag, for example, is made more intense by the blue background. The green foliage makes the red of the apple seem all the more red. The same principles apply in cases of successive contrast. If you stare intently at a chromatically coloured object and then look away, the after-image you experience will be the colour of its complement. A nice example of this is described by Goethe:

I had entered an inn towards evening, and, as a well-favoured girl, with a brilliantly fair complexion, black hair, and a scarlet bodice, came into the room, I looked attentively at her as she stood before me at some distance in half shadow. As she presently afterwards turned away, I saw on the white wall, which was now before me, a black face surrounded with a bright light, while the dress of the perfectly distinct figure appeared of a beautiful sea-green.³⁶

Evidence for the existence of these laws of colour appearance is our ability to exploit them. The reason why projector screens tend to be white, for instance, is that white objects reflect equally and in good measure all kinds of light: as a result,

³⁵ Chevreul 1839: §268, Broackes 1992: 201.

³⁶ 1810: §52. As Goethe puts it, in general "colours diametrically opposed to each other...reciprocally evoke each other in the eye", 1810: §50.

the colours that you perceive on the screen are determined by the colour of the light the projector emits, not the differences in the way the screen reflects this light (this is the converse of the point made in §3.4: if you want to know the real colours of material objects, you need white light, but if you want to know the real colours of lights, you need white material objects). The laws of colour appearance are also exploited by supermarkets, who apparently enhance the green appearance of their fruit and vegetables, thereby making them seem fresher, by using illuminants whose spectral composition is skewed towards middle- and low-wavelength light (in the terminology of §3.5, illuminants with a relatively high colour temperature): this light accentuates the comparatively high reflectance of green objects in these regions of the visible spectrum. Painters are similarly able to manipulate perceived colour by altering background colour: Delacroix famously boasted that he could even recreate the ‘radiant flesh of Venus’ from mud given the choice of a suitable background. And designers can exploit more general relationships between colours and perceiving subjects. Up to a point, for instance, the colour coding of information in a display increases its visual impact: subjects are able to better discriminate different parts of the display, and the information contained therein. Use too many, or badly chosen, colours, however, and colour coding loses this function (§5.3).

A different, but no less legitimate and fruitful, subject of scientific enquiry is the investigation into the colours themselves. There are features of colours and colour space that can only be investigated in chromatic terms. Consider the distinction between unique and binary hues, or elemental and derivative colours more generally. As we have seen, there is no structurally isomorphic distinction at the level of physical reflectances. Therefore we *can* only state facts like ‘orange is a perceptual mixture of yellow and red’ and ‘there are yellows that are neither reddish nor greenish’ using irreducibly chromatic vocabulary. Similarly for the internal relations of similarity and difference in which colours stand: as I argued in Chapter 6, the lower-level reflectances on which colours supervene do not stand in the same relations. Even though its subject matter is manifest, phenomenological investigation here, as elsewhere, is capable of offering genuine empirical insight. As we have seen, for example, studies into the structure of colour space tell us that the unique hues themselves stand in distinctive relations of similarity and difference

(§6.1). Even the unique-binary hue distinction is something that it took sustained attention to the phenomenology of experience to uncover.

The existence of this body of autonomous scientific knowledge is indicative of the fact that the colours themselves form a legitimate domain of enquiry. Although we can integrate the results of this enquiry into the results of enquiries into lower-level phenomena to at least some extent, when we inevitably reach facts that are not themselves further explicable in terms of lower-level processes we should not be surprised. Explanation has to come to an end somewhere. To conclude instead that we must be ignorant of the nature of colour just because *a priori* expectations about what should be further explicable are dashed seems foolhardy, even superstitious. We seem, to borrow a phrase from Locke, to do “much-what as wisely as he, who would not use his Legs, but sit still and perish, because he had no Wings to fly”.³⁷

Careful investigation into the nature of colour at once improves our grasp of what colours are and vindicates in outline our ordinary thought about colour. The inquiry into colour as a distinct *sui generis* phenomenon reveals that the naïve view of colour is neither systematically mistaken nor essentially incomplete. Colours are, as we ordinarily suppose, mind-independent properties. Moreover, even though there may be some respects in which our grasp of these properties could be better, colours are at least mind-independent properties whose essential nature is not hidden from view. We do not need to go beyond sense-experience to fill any remaining gaps in our conception of them: it is by investigating colours *as* colours that we achieve a better understanding of these properties. When we say that we see a colour this therefore does not amount to saying that we see something of whose nature we are wholly ignorant. In essence, we already know what colours are before we inquire into their nature. Colours are what we ordinarily think they are. Our common sense conception of colours is of itself clear and distinct.

³⁷ 1690: I.i.5.

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