Review of Matthen's Seeing, Doing, and Knowing: A Philosophical Theory of Sense Perception

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1 author:

Robert A. Wilson
University of Alberta
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Robert A. Wilson

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Critical Notice

MOHAN MATTHEN. *Seeing, Doing, and Knowing: A Philosophical Theory of Sense Perception*. Oxford: Oxford University Press 2005.

I Introduction

There is a venerable tradition in the philosophy and psychology of perception that views sensation as an input to perception, mediating between worldly stimulation of the organism and something more fully cognitive. Both sense data theory in philosophy and the idea of feature detection being a processing primitive in perceptual psychology, which hold that either objects themselves or our perception of them are constructions from sensational primitives, are prominent parts of this tradition. The cognitive processes for which sensation serves as input include object recognition, visual experience, and full-blown consciousness of the kind that anybody reading this critical notice will be undergoing (if only in the form of bored distraction). Sensory systems, which are responsible for sensations in the five traditional modalities plus the sixth sense of kinaesthesia or proprioception, our sense of body position (perhaps plus equilibrioception, our sense of balance, if we distinguish that from kinaesthesia, our sense of movement), are a kind of interface between world and mind, a kind of meat in the world-mind sandwich, to adapt Susan Hurley's (1998) characterization of perception.

In this initially daunting but ultimately enjoyable and informative book, Mohan Matthen argues that this tradition is mistaken about both the processes of perception or sensing and the relationship between sensation, perception, and cognition. Since this tradition is sufficiently alive and well in the contemporary literature to constitute something like the received view of perception and the role of sensation in it, Matthen's challenge and the alternative view he proposes are potentially significant. Sensory systems, Matthen thinks, are primarily devices for sorting

objects into kinds, a process resulting in sensory quality spaces that provide the basis for judgments about and inductions over what there is in the world perceived. Sensory systems do not deliver 'raw' sense data, fleeting qualia, or unordered sensations for true cognitive processing; rather, they deliver an output that is sorted and ordered, an output that is already, in traditional terms, conceptualized. Sensory experience or sensations (I follow Matthen in using these interchangeably in what follows) come not 'before' cognition but 'after' it. When we think about sensory systems in general, and not just the small subset of them that *we* possess, sensory *experience* is thus a kind of icing on the cake of perception, not one of its crucial ingredients.

That is the big picture painted by this book, and it joins a growing number of proposals for re-thinking perception that are inspired both by puzzles that the received view gives rise to (from how to construct the world from sense-data to Dennettian probes concerning just when the moment of consciousness occurs) and, more interestingly from my point of view, recent developments in the cognitive science of perception. The company that Matthen keeps here include Nick Humphrey's *A History of the Mind* (New York: Simon & Shuster 1992), the work of Alva Noë and J. Kevin O'Regan on the sensorimotor theory of perception, including Noe's recent *Action in Perception* (Cambridge, MA: MIT Press 2004), and Derek Melser's *The Act of Thinking* (Cambridge, MA: MIT Press 2004). Matthen's position is distinctive, however, and that is what I want to focus on below: the details that make this a room of one's own.

II Colour, Colour, Everywhere

One of the distinctive strands to Matthen's approach is its sustained discussion of colour perception, a topic on which his unorthodox views have developed over the past twenty years in a series of prominently published papers, the most recent of which show the influence of Evan Thompson's ground-breaking philosophical work on comparative colour vision (Thompson 1995, Thompson, Palacios, and Varela 1992). Matthen calls his own view of colours and colour perception an instance of *pluralistic realism*, a view that stands apart from both objectivism and subjectivism about colour. The pluralistic realist about colours holds (with critics of objectivism, such as Larry Hardin) that colours cannot be identified with any observer-independent property of objects or environments, such as spectral reflectances (see Byrne and Hilbert 2003 for a recent defence of this kind of objectivism). But neither are they properties of internal objects (qualia), nor are they simply to be defined in terms of our dispositions to have certain kinds of experience, as the currently popular dispositional theories of colour claim. No, colours have an

ontological existence independent of our responses — they are the causes of those responses, for a start — but it is wrong to look for them lurking in the world beyond the organism. They are instead products of an organism's engagement with objects in the world, properties that are the result of an organism's sensory interaction with the wavelengths emitted by light, including the interaction of these with objects in the organism's environment to produce surface reflectances.

In Matthen's broader framework, pluralistic realism takes the almost platitudinous view that *different sensory systems perceive different properties* in a radical direction by implying that a large range of species — including those to which we have little reason to ascribe much real phenomenology, let alone the kind of rich phenomenology that we take ourselves to possess — can sense colours. Pluralistic realism, so developed, raises interesting questions about both inter-specific ascriptions of colour sensitivity and the intra-specific variation of both that sensitivity and colour experience in our favourite species, *Homo sapiens*. More on both of these points shortly. But first an analogy to shed some light on Matthen's brand of pluralistic realism and its location in the conceptual landscape.

Consider the property of *danger*. Are there objects in the world that are (objectively) dangerous? Or is danger a property of us or some part of us, one that should perhaps be defined in terms of our dispositions, say, to experience fear or run away or engage in some other aversive or passive behavior? The first option, objectivism about danger, is made unattractive by the variation in what, in the first instance, people find dangerous and, in the second, by what different kinds of animals find dangerous (at least so far as we can tell). But the second option, subjectivism about danger, implies that there aren't really dangerous things in the world; rather, we mistakenly project the property of danger from ourselves onto the world (a kind of error theory), or there simply is no such property at all (a kind of eliminativism), or danger is to be defined in terms of our tendencies to react and respond in certain ways (a kind of dispositionalism).

Neither horn of this putative dilemma about the ontological status of danger need be grasped, however, if we recognize that danger is a product of an organism's engagement with objects in the world, one that results from an organism's interaction with things that could harm it. Different things can harm different kinds of organism — a person wielding a small baseball bat could harm you or me but not a blue whale, while someone wielding a fly swatter could do more than harm a fly but not harm a person. Thus what is dangerous can vary across different populations. This variation itself depends on empirical facts about organisms, their environments, and how they interact. Some things really are dangerous, however, and we can be mistaken about something's

being dangerous when it is not (e.g., some phobias), as well as be insensitive to the dangers that we face (where 'insensitive' here means 'do not sense at all,' rather than 'sense but pay diminished attention to'). The fact that there can be both 'false positives' and 'misses' with respect to dangerous things is a signature for the presence of a property that is not simply subjective.

Danger provides a good analogy for understanding and motivating Matthen's pluralistic realism in a number of ways, even if we might expect more bells and whistles in the case of something as complicated as, say, colour.

First, danger is a property for which there are plausible adaptationist, evolutionary histories that explain why organisms might well find certain things dangerous. The short version of this style of explanation is that creatures that didn't do so tended to find themselves removed from the gene pool; less whimsically, there was heritable variation in fitness for sensitivity to danger, presumably because of the correlation between contact with dangerous things and the propensity to survive and reproduce. Likewise, Matthen argues that a sensitivity to colour likely results from a range of selective pressures with evolutionary payoff. And like danger and harm, these vary across species in response to the particular ethology and ecology of each species.

Second, biological details about organisms are relevant to understanding not just the epistemology but *the ontology* of both danger and colour. In fact, there are at least two kinds of biological details in each case — physiological and evolutionary — and there is a natural way to weave the two together. We are trichomats, with channels for colour vision arranged on a black-white, a red-green, and a blue-yellow dimension that is specified by the kinds of receptors that we have in our visual systems (Ewald Hering's opponent process theory). Pigeons, as Matthen tells us (163, 173) are tetrachromats, having in addition receptors that are sensitive to the relatively short wavelengths of near ultraviolet (380-200 nanometers) electromagnetic radiation. This form of tetrachromacy perhaps evolved as a response to navigation in largely featureless but depth-full environments (e.g., high above oceans or land with limited landmarks).

These features of pluralistic realism constrain how promiscuous the attribution of colour vision is. There may be ultraviolet and infrared colour vision (e.g., in nocturnal creatures — puzzlingly, given Matthen's general views, a case that he doesn't discuss at all). But, so far as we know, there are no forms of non-spectral vision (outside of comic books), let alone colour vision, that use electromagnetic emissions in the X-ray or microwave range. Now to what I regard as some of the central problems that this proposal raises.

III Sensory systems and sensory experience

Matthen's view is that there can be sensory sorting — the activity of sensory systems in classifying and categorizing stimuli — without sensory *experience*. It is also his view that sensory sorting is widespread throughout the animate (meaning 'mobile,' not 'living') world. These two views are mutually supporting.

The first — the idea of sensory sorting without experience — suggests an understanding of the deliverances of sensory systems that is both *inflationary* with respect to how functionally integrated these processes and products are vis-à-vis the organism's cognitive system, and *deflationary* with respect to how phenomenologically enriched these processes and products are. The inflation with respect to functional integration provides the basis for adopting a comparative and evolutionary perspective on sensory systems, while the deflation with respect to phenomenology pre-empts the charge that Matthen's view is anthropocentrism run amok.

Conversely, if sensory systems are found throughout the animate world, then what sensory systems do had better (a) not require the phenomenology that, however liberal we are in our attributions, no one thinks is as extensive as sensory systems (think of snails, ciliated protozoa, or amoebae, for example); and (b) be well motivated in evolutionary terms. Tying sensory systems to action via classification is one solution that meets both (a) and (b).

The action-oriented aspect to this view of perception has the potential to make sense of large parts of perception. What is perception *for*? On the traditional view, perception records some kind of raw imprint of the world, which then gets processed downstream to reconstruct that world in terms of concepts and categories that we employ either consciously or unconsciously. On Matthen's view, sensing is not for producing a pre-cognitive sensory record of some kind but for behaving appropriately. In order to perform that function sensory systems must produce classifications and orderings, the kinds of functions usually thought to fall on the cognitive side of the perception / cognition divide. There are two kinds of worries here, however, one about the demarcation of sensory systems, the other about the notion of sensory experience. Let us begin with sensory experience.

Consider the function of sensory experience. Matthen thinks that it has a function, and that function is *epistemic*: it is to tell us what the classificatory outcomes of our sensory systems are. Why would we want to know *that*? Most creatures don't; their sensory systems are simply functionally integrated with the parts of their cognitive system that allow them to behave appropriately. And there is a stream to our visual system — the dorsal stream (a.k.a. the 'where' or 'how' system; see Milner and

Goodale 1995) — that operates, in at least some cases, independently of visual experience. Yet there are aspects of our behavior that are not coerced in this way. We can make decisions about which alternative action to undertake, given the input from our senses (and, I assume, from elsewhere, in many cases). Sensory experience allows us to do this by acting as a medium of storage for sensory classification.

But we might wonder about whether sensory experience and the possibility of non-coercive action line up in the way that this account suggests. As any computer programmer knows, actions that are alternatives to one another can be generated without a whiff of consciousness on the part of the program, and many working on animal behavior can marvel at the apparent non-coercive behavior of their subjects without thinking there is 'anybody home.' Matthen's explicit definition of sense experience (as given on 242-3) reinforces rather than resolves the problem here, since it says (more or less) that sense experiences are signals with a certain functional role that do not coerce action. This seems to allow for sense experiences — not just sensory systems — that are not conscious at all. Many sympathetic to Matthen's view of sensory systems (and here I count myself) are likely to think that this shows that the notion of sensory experience he articulates is mistaken.

This is related to the other worry I mentioned above, the one about the demarcation of sensory systems. How do we distinguish, on Matthen's view, between things with sensory systems (especially those with sensory experience) and those that are simply more or less complex devices for the input and output of information, and that use that output for further action? Here I'm happy to be liberal about comparative vision, to acknowledge the efforts of bioengineers who *build* sensory systems (or parts of them), and to sign on to the general enterprise of artificial perception. But I would be much less happy to sign on to (say) cars having sensory systems (vs merely having sensors for various functions), or extending that notion to houses with alarm systems or other relatively mundane input-output devices, let alone ascribing sensory *experience* to such devices. The problem is that there's nothing that I can see in Matthen's general views, or in his explicit definitions of key notions, such as that of a sensory state and that of a sensory experience (again, 242-243), to rule out these kinds of case.

This is a more pressing problem for Matthen than for proponents of the traditional view, since on that view sensory systems are distinguished by the fact that they produce some kind of experiential state (e.g., the 'raw feel' of sensation). But that's precisely what (most?) sensory systems don't produce, according to Matthen. Perhaps an appeal to complexity here will help, either to internal design or flexibility in behavior. Or, since Matthen holds what he calls *The Coevolution Thesis* ('sensory systems coevolve with effector systems. Their function is to

provide effector systems with information specific to the performance of the behaviours produced by the effector systems' [228-9]), it might be that he can appeal to evolutionary history here as a way to pick out true sensory systems from (say) their artifactual imitators. Other alternatives here include the idea that we simply enumerate our paradigm sensory systems, and that we do a lot of bullet biting. ('Yep: there can be experience without consciousness. Yep: cars *do* have sensory systems, just restricted ones.') My gut feeling, however, is that none of this is likely to be very satisfactory.

IV Colour vision and colour experience

Whatever one thinks of the general separation of sensory systems from sensory experience, the case of colour raises special concerns. As might be expected given his general view of sensory systems, Matthen offers the following functional definition of colour vision at the end of Chapter 7:

> Colour vision is the visual discrimination capacity that relies on wavelength-discriminating sensors to ground differential *learned* (or conditioned) responses to light differing in wavelength only (187; see also 166).

Note three things about this definition worthy of further comment:

(i) *colour vision involves the eyes* (something made more explicit in his preceding definition of colour classification) and, more generally, visual sensors. This is supposed to rule out putative counter-examples, such as the infrared skin sensors of the pit viper (due to Peter Bradley; see the note on 166) — I'm doubtful that it does since the pits in vipers feed into its nocturnally adapted visual system. But it also raises another question. Since colour features in cognition beyond vision (such as in memories, dreams, and acts of fancy), we need to rely on one or the other components of this view to understand coloured experiences in general, or to show how vision constitutes a foundation for these other experiences.

(ii) *colour vision processes wavelengths of light*. This is the grain of truth in the physicalist identification of colours with particular ranges of wavelengths of light (e.g., Hilbert's view). By explicitly omitting mention of the range of wavelengths and their correlation to *our* colours, it facilitates pluralistic realism about colour vision.

(iii) *colour vision grounds learned responses to light*. The chief motivation for this initially puzzling feature of the definition is to respond to a version of the worry raised at the end of the preceding section

> — to distinguish real colour vision systems that *represent colour* from what we might call *mere wavelength responders* (see 164-167). But I would say that this condition makes a kind of verificationist error, confusing a crucial test for colour vision (vs mere wavelength responders) — learnt discriminative capacities — for the essence of colour vision. I think it is symptomatic of a problem mentioned earlier: a failure to take seriously enough the problem of demarcating both sensory systems and sensory experience in the framework that Matthen advocates.

The deeper worry about the idea of colour vision without colour experience, for many philosophers and I suspect a few scientists, is that it will strike them as oxymoronic. This is an issue that Matthen addresses head-on, quoting (on 167) both P.F. Strawson ('Colours are visibilia, or they are nothing') and David Hilbert ('Colours that cannot be seen ... are not plausibly colours at all'). Matthen replies that such views reflect an anthropocentric bias in the conception of colour, the idea being that they consider *our* colour vision system to be paradigmatic and apply criteria perhaps appropriate when considering it, to colour vision systems more generally. That *might* be what is going on, both in the philosophical literature on colour and for colour-literature-naïve thinkers (for I think the Strawson-Hilbert intuition is widely shared), but to see what the worry is, consider the case of pain, a phenomenon that, somewhat to my surprise, is not discussed in *Seeing, Doing, and Knowing*.

I suspect that the claim that 'Pains that cannot be felt are not plausible as pains at all' (or even modally weaker forms of this claim) would be widely accepted. Why is that? Many who get beyond simple bafflement at the question would say that this is a fundamental conceptual truth about pain: pains are necessarily, of their nature, phenomenological or experiential states. Now, there is a large and sophisticated literature on pain, pain being of professional interest to physiologists, pharmacologists, medical practitioners and researchers, psychiatrists, and others in the health professions, as well as philosophers. Pain is processed by the *nociceptive system*, which in us begins with both mechanical and polymodal nociceptors in the skin, muscles and viscera, and then passes information on to the central nervous system through both myelinated and unmyelinated axons (the notorious A and C-fibres, respectively). There's much more detail here, of course, perhaps as much as in colour vision (see Hendry 1999 for a taste). Pain is certainly felt in species other than our own, and there is likewise an adaptive evolutionary history behind the existence of each of the distinctive nociceptive systems there are. But it looks as though pains that cannot be experienced are not an option, and thus there is no intermediate stage in models of pain that allow for *pains* that aren't felt. There's lots of physiology, and at the end of it all,

there's the feeling of pain. I suspect that those who are empirically-inclined who accept the Strawson-Hilbert view of *no colour experience, no colour vision* think that colour is like pain: there may be responding to wavelengths of various kinds, but there's no *colour perception* without colour *experience*.

This example raises another question, itself leading into some thornier issues for Matthen. The nociceptive system is much like a sensory system, one that has evolved to detect local damage to the organism's body. While we might use its 'inner directed' function to distinguish it from sensory systems proper (with their 'outer directed' functions), we might also extend Matthen's perspective on sensory systems to the nociceptive system itself. *Its* function is not really to detect local bodily damage, but to use that to detect stimuli that hurt the organism (cf. the earlier analogy between colour and danger). After all, proprioception is properly regarded as a sense, in addition to the traditional five senses, and it seems much like nociception in its sensitivity to local bodily changes as an attention-grabbing mechanism with a worldly focus.

This, in turn, raises a dilemma. If we think of nociception itself as a sense, albeit one whose perceptual states — those of pain — are essentially experiential, then pain would seem to be a counter-example to the claim that sensory systems *in general* don't themselves entail sensory experience. On the other hand, if we deny that nociception is a sense, perhaps using the intuitive distinction between cognitive systems that are 'inner directed' and those that are 'outer directed' as our basis, then we not only lose proprioception as a sense but introduce a large complication into the view that Matthen defends. Since surely much of, and many aspects to, the overall process of sensing in the five traditional modalities are inner directed, does this mean that *they* are not properly thought of as sensory? More generally, this draws attention to the coarseness of Matthen's global claim that *the* function of sensory systems is sorting, and that sorting precedes *any* experience.

This ties in with a larger issue. Matthen offers a general view of sensory systems but the core worked example is that of vision, and within that domain, that of colour vision. There is some brief discussion of olfaction (chiefly in the context of visual reference and the place of spatial location in sensing in Chapter 12; see especially 282-9), but no real consideration of the topic of 'unsmelt smells' (or, for that matter, 'unheard sounds,' or 'unfelt touch'). This reflects the concentration on vision that one finds in the literature and it would have been interesting to read Matthen's thoughts on ways in which that concentration constitutes a distorting bias (vs the only effective way forward for a philosophical view that seeks to be empirically informed). The problem that pain raises is not only whether colour should be, as proponents of the Strawson-Hilbert

view would likely maintain, assimilated to pain, but whether some of the other sensory modalities should go the same way.

V Sensory systems beyond the head?

While departing from orthodoxy in adopting a particular comparative perspective on sensory systems, Matthen follows the bulk of the literature on sensory perception and assumes that sensory systems are physically located within the boundaries of the organism. There are reasons to think that this assumption is false of at least a range of cases, and together with taking the idea of situated cognition seriously — as Matthen himself does in focusing on what perception is for and its intrinsic ties to action of some kind (even if it is just 'epistemic action') — this provides grounds for thinking that sensory systems extend beyond the head in a larger range of cases (see also Wilson and Clark in press).

Relatively clear cases in which sensory systems extend beyond the boundary of the head, cases in which they involve wide computational systems (Wilson 1994, 1995: ch. 3, 2004: ch. 7-8) or extended minds (Clark and Chalmers 1998, Clark 2001) are those in which an organism generates its own sensory field, such as in bat echolocation and the electric fields of fish, such as those in the weakly electric fish family in South America (see Nelson and MacIver 2005, MacIver in press). In such cases, organisms expend energy in creating a field (acoustic or electric in these cases) that they then interact with through motion in order to hunt, feed, mate, or navigate. It is at best very strained, in my view, to argue that these fields do not physically constitute part of the sensory system of these organisms — and are, instead, say, simply resources used by, or inputs to, bodily bounded sensory systems — as a broader consideration of their sensory ecology and evolution implies. These sensory systems are, in Richard Dawkins' (1982) terms, *extended phenotypes* of the organism, and they are adaptations that have been selected for much as their *internal* sensory physiology has. In at least these cases, sensory systems are extended, and they provide examples of a fairly radical form of externalism about the mind, one that doesn't appeal to intuitions about 'content,' or claims about what happens on Twin Earth. In such cases, a slab of sensory processing, some of which is almost certainly computational, takes place outside of the body of the organism.

One of the functions of such extended sensory systems is to ease the 'in-the-head' computational and representational load, much as is the case of sensory off-loading where non-sensory body parts, such as the forelimbs of the legs of crickets, are recruited as part of an overall sensory function (in this case, phonotaxis). By redistributing computation beyond the nervous system, adaptive behavior is clearly facilitated, as a

closer look at any of the above examples reveals. And in all of these cases, it is not just aspects of the self-generated environment that are recruited as sensory resources, but parts of the organism's own body.

To take an example closer to home ground for Matthen's own views, consider the optic flow created when an organism moves through space. (Although Matthen mentions J.J. Gibson in a few places in connection with the idea of action-orientation, higher-order invariances, and affordances, he doesn't take up this core topic in Gibson's work.) When the optic field flow expands, it indicates, in conjunction with the organism's movement, that it is approaching some fixed point, while contracting optic flows indicate a growing gap between organism and object (Gibson 1979, 227). Recent research in neuroethology on the visual systems of flies has focused on ways in which flies detect self-propulsion in order to stabilize their flight pattern. Facts about the geometry and physiological wiring of the fly's photoreceptors simplify the computation of optic flow (see Egelhaaf et al. 2002). For example, the dendrite of a tangential cell (VS6) likely integrates the input from sensors that detect optic flow patterns. The sensors (the ommatidia) that feed the neuron detecting a fly's rolling motion (as when it tips to one side) are located in a row that lies parallel to the pattern of optic flow. Given that the change in optic flow characteristic of rolling is typically caused in the fly's usual environment by the fly's own motion (rather than by an evil scientist playing The Matrix), activity in this neuron indicates to the fly self-motion. Both of these physiological set-ups contribute to simplifying the computation of optic flow in ways that connect the fly's visual system more effectively to behavior.

It is this kind of example that provides the connection between what we might regard as the exotic cases of paradigmatic extended sensory systems (the echolocating bat, the electrically-sensing fish) and more familiar and mundane examples of sensory systems. For *lots of creatures, including us*, operate visually in part through optic flow, and through a variety of other means whereby aspects of the organism's environment and their interaction with and manipulation of it are crucial to the visual tasks that they undertake. This is just what we should expect if, as Matthen implies, sensing is a kind of doing, a kind of activity, a way in which organisms extract and exploit information from their environments through their bodily interactions with it. Eye movements, foveation, saccading, head-turning and other forms of head movement and even squinting are all familiar ways in which organisms like us adjust themselves with respect to their environments in order to improve their visual performance. Once we conceptualize sensory systems in dynamic terms, such that we consider not only their in-the-head functional decomposition but also their in-the-world functional role, then this creates

a pressure to see more and more of their activity as extending into the world.

We are indeed far from the idea of the static retinal image as containing a two-dimensional sketch of the world from which a full three-dimensional representation is constructed. One question for Matthen is whether he is in for the full ride, or, if not, just where it is that he gets off.

VI Two kinds of universalism about colour

One of the views that Matthen rails against is something called 'universalism' about sensory systems, with universalism about colour vision a particular target. This is just the idea that a given sensory system (let it be that for colour vision) must be universal across all species in that it must function either to detect the same properties (if you're an objectivist) or to generate the same qualitative space (if you're a subjectivist or some other kind of 'irrealist'). But different strokes for different folks, says Matthen. For us, wavelengths of light are detected largely by reflection from the surfaces of objects. This is in part why we often see colours as properties of surfaces. Birds, by contrast, detect some wavelengths — those in the ultraviolet range of the spectrum — as properties not of surfaces but *of directions*. Because ultraviolet light is scattered more by the atmosphere than light of longer wavelengths, birds can use the concentration of ultraviolet as a guide to direction relative to the sun. Matthen claims that 'for the bird, colour is a property of directions as well as of surfaces. For its surfaces are comparable to directions with respect to colour: for instance, directions perpendicular to the sun are the same colour as ultraviolet plumage' (173).

Making sense of ultraviolet *colour* vision (and, I assume, *infrared colour vision*) will be hard enough for some; ascribing the corresponding non-spectral colours to objects and to directions might well be too much. Here I am with Matthen: making that second move should be no more difficult, once the first is made, than understanding how we can ascribe colours both to objects (through reflectance) and to images (through illuminance). I think that the first move, however — to allow not only ultraviolet (and I assume infrared) vision, but non-spectral *colour* vision — is less compelling than Matthen, along with many of those working on comparative colour vision, thinks (see also Byrne and Hilbert 2003: 15-16, 57).

Suppose that we grant, as I'm inclined to do, the pluralistic realist view that different biological taxa can represent colours, and can represent them with their own sensory ordering system (di- tri- or tetrachromatically, and with or without ultraviolet and/or infrared). What are we to say about the universalism of colour vision *within* a species? (I assume

that the species is the chief taxon that Matthen has in mind, since it is the only one that is really discussed.)

One kind of intra-specific variation that Matthen's view handles nicely (32-4) is that of classic spectrum inversion, where (in his terms) two individuals have the same sensory classification system (that's why one can't detect differences between them) but have different subsequent visual experiences (e.g., the experience of seeing red vs that of seeing green) that provide different epistemic handles on their indistinguishable sensory classification systems. But I have in mind another potential source for intra-specific variation, and that is *language*.

Although pluralistic realism is a thesis about colour vision and more generally sensory systems across species, its endorsement makes salient Matthen's relative silence about one of the larger controversies over colour at the interface of the cognitive and social sciences: whether there are universals that hold of colour vision despite the cultural variation that one finds in not only the number of colour terms (from 2 to hundreds) but in the hues that each of these terms picks out. Berlin and Kay's (1969) classic comparative study of colour found that there were such universals, the chief of which purported to constrain the sequence in which colour terms were introduced into a language. (Every language has terms for black and white [or dark and light]; if a language has one additional term, it corresponds at least roughly to red; if it has further terms, then next will correspond roughly to green or yellow, and so on. See Berlin and Kay 1969, Hardin and Maffi 1997.) To simplify massively but hopefully not so much as to distort the views beyond recognition: Berlin and Kay argued that color vision was strongly biologically constrained, and this pattern of constraint undermined forms of the linguistic relativity hypothesis, associated most prominently with the linguists Edward Sapir and Benjamin Whorf. The Sapir-Whorf hypothesis claims, in its strongest form, that natural languages (of which there are over 5000) determine how people 'see the world,' including how they see colour. On Berlin and Kay's view, the linguistic variation there is occurs against a backdrop of biologically constrained patterns that persist across distinct languages and language groups

The Berlin-Kay view is one that Matthen should have some sympathy with, and although (as I've said) his discussion here is minimal, that sympathy does emerge in several places. That sympathy, however, gets him into trouble, primarily because the Berlin-Kay view has been formulated very much within the tradition of perceptual thought that Matthen rejects. The Berlin-Kay view is not simply that there is some kind of early stage of the complete process of colour vision that involves sorting or discrimination that is biologically constrained. That would hardly constitute the basis for a response to the radical-sounding claims of linguistic relativists who say that *our experience of the world* is relative to the

language that we use to demarcate that world. Rather, as it is commonly (and I think not misleadingly put), the Berlin-Kay view is that there is a level or kind of colour *experience* that is prior to, and impenetrable to, the effects of language.

This seemingly undetected mismatch between the overall views of perception that proponents of the Berlin and Kay hold and Matthen's own view leads to problems in the brief discussion that Matthen has of their views. For example, he says that 'there are cultures in which colour categories are somewhat different from those ... that we employ in English, even though practitioners of these cultures [I think here he means people] presumably sense the world in precisely the same way as English-speakers do' (82). But this presumption is precisely what can't be made within a framework in which the immediate output of sensory systems is a conceptually laden *classification* — unless one assumes that language in general doesn't influence, sometimes in significant ways, one's scheme of classification. Later on the same page Matthen says, of the Berinmo of New Guinea, who, unlike us, do not distinguish blue from green, 'the Berinmo are led by precisely the same pair of perceptions [of the sky and grass] to the *same* belief concerning both sky and grass. Since there is every reason to think that the Berinmo sense colours the same way as other humans, it is reasonable ....' I assume that the 'every reason' here is supposed to be supplied by the Berlin and Kay (and related) studies, together with the established physiology of colour vision in *Homo sapiens*.

If we held the traditional view of sensing, whereby there was some non-conceptualized sensation that was the immediate product of sensory systems, then such a view would have some plausibility. But once we reject this view, as I think we should, in favour of the kind of view that Matthen advocates, it is more problematic to interpret at least the Berlin and Kay results in this way. We need some independent ground for thinking that, although the structure of a population's environment and what its cognitive system has constructed as salient for it can partially determine the nature of its sensory orderings, language does not do this. Perhaps there is such a ground (e.g., appeals to physiology), but I am skeptical.

One way to highlight the oddity here is that while Matthen encourages us to give up any lingering anthropomorphism regarding colour vision, he doesn't seem as keen to explore what might be called (*cum grano salis*) any lingering Anglomorphism in the cross-cultural investigation of colour terms that Berlin and Kay inaugurated (see Lucy 1997). Pigeons can see colour as a property of directions, but what of the Dani, with just two terms for colours that divide the world into light and dark? Why think that either the Dani's sensory experiences or even their (not necessarily conscious) sensory states are the same as our own, given that these

occur *downstream* of the classifications that their sensory systems perform? Or consider the common, cross-cultural associations of 'red' with danger, excitement, and sexual arousal (Sahlins 1976). Why assume that there is some kind of output of sensory systems that is shared across our species, no matter how rich and distinct our language-infected experience of colour is? Unless culture, and so language, cannot contribute to structuring one's system of classification — and as intimated in the last paragraph here we need some special reason to treat culture and language apart from other aspects of an organism's ecology — these seem like questions that remain more open than I think Matthen is supposing.

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ROBERT A. WILSON
University of Alberta
Edmonton, AB T6J 2E5
Canada

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