Color Ontology and Color Science

Jonathan Cohen*and Mohan Matthen†

1 Prospectus

1.1 Description

When recent results in color science were introduced into philosophical writing about color in the late 1980s and early 1990s, the results were dramatic: by bringing these empirical findings to bear on long-standing ontological and epistemological questions about color, philosophers were suddenly able to make genuine inroads on problems on which there had been no significant advances for generations. At the same time, philosophical attention to empirical color science has fostered inquiry into the conceptual and methodological foundations of the relevant sciences. As a result, there has been a flowering of both empirically informed philosophical work and philosophically informed empirical work on color; this work is routinely discussed in top journal articles, conferences, and graduate seminars, and has been the subject of a number of anthologies and monographs.

In the last five years, theorists in this tradition have turned their attention to a number of empirical phenomena concerning color perception that had not been adequately appreciated in earlier work, and that have substantial implications for our understanding of color properties and color perception. These phenomena include:

- variability of color perception across species and individuals, and in different kinds of perceptual circumstances;

- the co-evolution hypothesis (the view that the colors of plants and animals evolved together with systems for color perception in animals);

- color categorization (why do visual systems naturally break the continuous range of colors into a small number of categories — red, blue, orange, etc., and what determines the categories used by a given visual system?); and

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*Department of Philosophy, University of California, San Diego, 9500 Gilman Drive, La Jolla, CA 92093-0119, joncohen@aardvark.ucsd.edu

†Department of Philosophy, University of British Columbia, 1866 Main Mall E370, Vancouver BC Canada V6T 1Z1, mohan.matthen@ubc.ca

- uses of color vision (i.e., what is color used for within the human or other cognitive systems?).

We propose an anthology of essays devoted to these themes. We are convinced (partly by the results of a pair of conferences in 2002–3 out of which the idea of the present anthology grew) that the time is ripe for substantive interchange on these matters between philosophers and color scientists, and that our contributors have many new, controversial, and rich ideas to develop on these topics.

1.2   Outstanding Features

The essays in the proposed volume would reflect a number of empirical issues about color (and new philosophical responses to them) that have become increasingly important in the time since the now-standard anthology (Byrne and Hilbert) and monographs appeared. These issues have been of interest to specialists (including, of course, the contributors), but have been to some extent hidden from general philosophy of mind/perception circles. The proposed anthology, therefore, would present the state of the art, as it is conceived of by the leading researchers in the field, and therefore make the new empirical and conceptual material available to a wider audience.

1.3   Competition

The standard anthology on color is now Byrne's and Hilbert's two volume *Readings on Color* (MIT Press, 1997). This anthology is a very nice collection of philosophical and scientific articles on color. It usefully gathered together articles that were almost all in print elsewhere, together with a substantive introduction, a long bibliography, and a glossary of technical terms — in short, it provides philosophers of mind and others who don't specialize in color with what they need to get up to speed on the issues about color. What has made Byrne's and Hilbert's anthology so authoritative is that it lays out the relevant groundwork and covers contemporary classics through 1997; however, philosophical work on color really has grown and changed since the appearance of their volumes (partly *because* of the appearance of their volumes!) — e.g., by paying increasing attention to issues about variations in color vision, color categorization, and the uses of color vision. For this reason, it seems to us that an update is warranted. The anthology we are proposing would be just such an update, made up of newly commissioned articles by leading researchers (including Byrne and Hilbert themselves).

A more current anthology on color is Mausfeld's and Heyer's *Colour Perception: Mind and the Physical World* (Oxford, 2003). This book, which grew out of a year-long interdisciplinary workshop on color in Bielefeld, contains a number of excellent articles, together with commentaries by other workshop participants. Many of the essays in this volume are very long, and attempt to articulate and defend the assumptions undergirding the authors' research,

often contrasting these with the assumptions of other authors (typically others from other disciplines). (Unfortunately, this anthology sells for $144.50, which puts it out of reach of graduate students and many academics, and prohibits its adoption for seminars.) But these essays are not in the most part aimed directly at philosophical concerns (even when they take up empirical issues that have important philosophical implications). In contrast, the essays in our proposed anthology would use these sorts of empirical issues to address philosophical disputes, and so would likely be more attractive to the philosophical audience.

A third anthology is Hardin's and Maffi's *Color Categories in Thought and Language* (Cambridge, 1997). This volume, also derived from an interdisciplinary conference, gives a nice overview of current thinking about color categories in linguistics, anthropology, and perceptual psychology. However, here too there is too little direct contact with philosophical issues to entice the general philosophical reader. Moreover, while the subject of color categorization is certainly important, it is only one among many important phenomena that should constrain philosophical discussion of color. Our volume would include discussions of color categorization, but (unlike Hardin's and Maffi's volume) would not be constrained to this one issue.

(A few other non-philosophical anthologies on color have appeared in recent years, including Backhaus's, Kliegl's, and Werner's *Color Vision: Perspectives from Different Disciplines* (de Gruyter, 1998) and Gegenfurtner's and Sharpe's *Color Vision : From Genes to Perception* (Cambridge, 1999); but these contain very little philosophy, and hence will not compete with the proposed volume for the attention of non-specialist philosophers.)

1.4 Apparatus

The book will be an anthology of newly commissioned essays. We anticipate that it would include a bibliography, but not examples, cases, questions, problems, glossaries, references, appendices, etc. There will be no supplementary material associated with the book.

1.5 Audience

The anthology is primarily intended for students (advanced undergraduate through graduate) and professors of philosophy. However, there should be a secondary market for the anthology in allied fields (e.g., psychology, linguistics, anthropology); several of the authors are from these other fields, and the content of the essays really does cross over disciplinary lines. The essays won't presuppose familiarity with earlier debates about color, but will present the issues in a contemporary and up-to-date way. It will be written at a level that is accessible to advanced undergraduates. The essays will be almost wholly (perhaps wholly) descriptive rather than quantitative, and require no mathematical prerequisites.

1.6 Market Considerations

The anthology would be important reading for those interested in philosophy of mind, philosophy of psychology, philosophy of cognitive science, and philosophy of perception. In addition, the anthology will be of interest to those in vision science, cognitive science, perceptual psychology, and some parts of anthropology. There is every indication that interest in this sort of interdisciplinary work on color is large and growing. Since we have commitments for contributions to the volume from many of the top researchers working in the field, we have every reason to believe that we can capitalize on this existing interest.

1.7 Status of the Book

We have secured commitments for all of the (new) essays listed below in the table of contents. We have not set a deadline for these essays, but there are drafts of at least two of the essays already (one each from Cohen and Churchland), which are enclosed. Assuming we will have 13 essays, this means that 2/13 are complete now. We could reasonably ask the contributors to complete their essays one year from the time the volume is accepted for publication. The total length of the anthology would depend, of course, on the length of the essays contributed; but it seems reasonable to set a 6,000 word limit on the essays, which would come to 78,000 words. We don't now know how many figures would be involved, since that would depend on what the contributors wanted; however, we'd certainly urge them to keep this to a minimum.

1.8 Reviewers

Most of the obvious reviewers are people who have committed to submit essays, and so are ineligible. However, here are some suggestions among philosophers: Gary Hatfield (`hatfield@phil.upenn.edu`), Adam Pautz (`apautz@mail.utexas.edu`), Ed Averill (`edward.averill@TTU.EDU`). In color science/psychology, you might consider: Jack Werner (`jswerner@ucdavis.edu`), Quasim Zaidi (`qz@sunyopt.edu`), or David Brainard (`brainard@psych.upenn.edu`).

2 Table of Contents

Here are abstracts of papers proposed for the anthology.

1. Justin Broakes, Brown University: (Title not available)

   Important arguments for a form of eliminativism or anti-realism about colour have been developed by C. L. Hardin. There are objections to the ideas of normal observers and normal conditions, and there are objections from the difficulty of getting agreement among people on (for example) what counts as 'unique green'. I shall be arguing, by contrast, that a form of limited realism about colour is defensible, but only if one acknowledges

many of the points that Hardin thinks make realism impossible. To the question whether some objects are 'really' coloured, in the sense 'genuinely and truly' coloured, I propose the answer Yes; but that is while admitting, indeed insisting, that the kind of property of redness, for example, is, may still in some sense be relational and subjective.

There are three main ideas that converge on the view being proposed: (a) If the import of a statement is relatively little, then it is relatively easy for it to be true. And that means that, if we have a sentence of the form 'a is F', then it will be relatively easy for a genuinely to fall under the predicate 'F'; and relatively easy for the object to possess the property of F-ness. We are quite happy to allow there are untidy rooms and overdrawn bank accounts precisely because these categories — whether empty or instantiated — are obviously categories of pretty insubstantial things; that in turn makes it relatively easy for them to be instantiated. And maybe the category of red car or green grass makes a similarly minor claim on reality. (b) Locke's conceptualism equates these four items: having the essence Man, having what makes something of the species Man, conforming to the idea Man, and having that which gives something the right to the name 'Man' (Essay 3.3.12). What gives something the right to a name like 'Man' may be possession of a scientific 'real essence'. But not all terms aspire to be terms for a scientific kind: what gives something the right to the name 'untidy' is only (we might say) the satisfaction of a nominal essence. In the case of colour, I suspect that people's impulse to deliver an error theory comes from the idea that a belief that fire engines are really red in some sense includes a belief that there is a scientific essence of redness — so if no scientific essence can be discovered in rerum natura then there is no redness at all. But if we only recognize being red as just: how a thing has to be in order to be correctly classified as red, then we can see how a thing can truly be red without there being any scientific essence to be found. (c) We need to examine more deeply the content of colour claims — what actually is meant when we say that a car is red. And the investigation helps us assess the prospects for the idea that colours may in some sense be 'autonomous' properties, capable of doing their own explanatory work, though not precisely in the same way as the terms of physical science. But the view is not quite the same as views of the naivety or primitive content of colour perception advanced by some other recent writers.

2. Alex Byrne, MIT, and David R. Hilbert, University of Illinois, Chicago: What do "color blind" observers see?

Abstract: What do "color blind" observers see? The question is one of interest to both color scientists and philosophers of perception. It concerns issues in the "problem of other minds", opponent-process theory, color realism, and consciousness. The paper examines the question by considering empirical theories of color vision deficiencies and current work in the philosophy of perception.

3. Paul M. Churchland: UCSD: On the Objective Reality of Colors: How Qualia Space maps onto Reflectance-Profile Space

Abstract: How, if at all, does the internal structure of human phenomenological color space map onto the internal structure of objective reflectance-profile space, in such a fashion as to provide a useful and accurate representation of that objective feature space? A prominent argument by Larry Hardin proposes to eliminate colors as real, objective properties of objects on grounds that nothing in the external world (and especially not reflectance profiles) answers to the well-known and quite determinate internal structure of human phenomenological color space. The present paper proposes a novel way to construe the objective space of possible reflectance profiles so that 1) its internal structure becomes evident, and 2) that structure's homomorphism with the internal structure of human phenomenological color space becomes obvious. The path is thus re-opened to salvage the objective reality of colors, in the same way that we salvaged the objective reality of temperature, pitch, and sourness - by identifying them with some appropriate microfeature of material objects.

4. Austen Clark, University of Connecticut. Color experience and the architecture of early vision: Notes on a tentative taxonomy

Abstract: Larry Hardin has often posed the question: If a subject can make chromatic discriminations, why should that subject also have experiences of colors, or be aware of colors? What does the latter get you that you didn't already have? This paper makes a stab at providing a tentative answer to this question. Source materials for it lie in the architecture of early vision, in which bottom-up, high-bandwidth, parallel and preattentive feature extractions are followed by lower bandwidth, mid-level, attentional processes. The interface between them is controlled by the competitive and selective processes of selective attention. There are interesting taxonomic distinctions between processes at differing places within this architecture, some of which are described. The paper draws two conclusions; first, that the traditional notions of "visual experience", "phenomenal property" and "qualia" are not uniquely descriptive of any one level within the architecture, but can instead, in one sense or another, characterize processes at several different levels. So these traditional notions blur distinctions we must endeavor to keep precise. Second, and somewhat more optimistically, understanding the structure of the competition controlling the interface between feature extraction and mid-level attentional systems can help us make sense of the distinction between mere sensing and sensory awareness. That the competition has winners and losers is shown to cast some light on Larry's question.

5. Jonathan Cohen, UCSD: It's Not Easy Being Green

Abstract: Color relationalism holds that colors are constituted in terms of relations to perceiving subjects. One of the most important benefits of such accounts is that they smoothly accommodate the the wide range of

perceptual variation that, Hardin has argued persistently over the years, present serious obstacles for other accounts of color ontology. However, Hardin has recently argued that color relationalism is unacceptably unconstrained — that it results in the ascription of more colors than there are. In this paper I'll show how the view respects the constraints on color ascription Hardin thinks it does not.

6. Don Dedrick, University of Guelph: Perceptual and cognitive accounts of color categorization: C. L. Hardin's "lookism"

Abstract: Contemporary theories of colour categorization may be characterized as perceptual or cognitive. Perceptual theories hold that it is primarily the way things look that drives categorization. Cognitive theories argue that it is the computation of some cognitive value (e.g. relative similarity) that determines categories. Since the publication of Color for Philosophers (1988), C. L. Hardin has promoted a perceptual account. In my paper I trace the development of Hardin's view and its links to other perceptual accounts (Paul Kay's, especially). I examine the evidence Hardin finds compelling (mainly psychophysics, human & primate) and argue that it cannot support a mostly perceptual account. Along the way, I attempt to get clear as to what "mostly perceptual" can mean.

7. Kimberly Jameson and Nancy Alvarado:

8. Rolf G. Kuehni: Color space: the natural outcome of cone filtering

Abstract: Three-dimensional color spaces and color solids have been under development since the mid-eighteenth century. The are regarded as cultural artifacts by critics of the color vision and color science enterprises. The paper describes that they are the natural outcome of dimension reduction of spectral power distributions by filtering with the three cone functions. Such filtering, in principle, makes possible the reconstruction of up to 90% of information contained in spectra. But this fact does not provide support for color objectivists. Color symbols assigned to cone output signals depend in manifold ways on general and personal factors of color vision.

9. Brian McLaughlin, Rutgers University Abstract: Hardin has argued for color irrealism (the view that nothing is really colored), in part, on the grounds that there are no wholly objective notions of normal perceivers and normal circumstances of visual observation. I am in agreement with him about there being no such notions: any notion of normal perceivers or normal circumstances will be, at least to some extent, a matter of stipulation, rather than discovery. I disagree with Hardin, however, over whether this consideration should led us to color irrealism. I shall argue that a radically relativized color realism is defensible, and far more plausible than color irrealism

10. Mohan Matthen, University of British Columbia: Pluralistic Realism

Abstract: C. L. Hardin's argument against colour realism appeals to the non-correspondence of perceived colours to any physical property. A particular difficulty in finding such a correspondence is the phenomenon of sensory variation: colour appearance varies from circumstance to circumstance, observer to observer, species to species. Here it is proposed that the supposed difficulty for colour-realism rests on a mistaken notion of the function of perceptual systems like colour vision. If it is supposed that they must "measure" a physical property, then realism would demand that there be some one physical property corresponding to colour appearance, and sensory variation would make realism implausible. This paper floats an alternative approach to understanding perceptual systems. It is proposed that they group distal stimuli together for epistemic purposes: that is, two things present the same appearance if they ought to be treated similarly for epistemic operations such as induction, object-identification, and so on. On this account, correctness with respect to perceptual appearance consists in its being correct that two things which appear the same ought to be treated the same for these epistemic operations. It is shown that this approach accommodates sensory variation while remaining realist in its orientation to colour.

11. Rainer Mausfeld, University of Kiel: Material Colours Abstract: The chapter will first briefly present an internalist account of 'colour' according to which the internal concepts 'surface colours' and 'illumination colours' are part of the data format of two different representational primitives. On this account, the internal concept of 'colour' is not an autonomous and unitary one but rather refers to two different types of 'data structure', each with its own proprietary types of parameters and relations, in which 'colour' figures as a free parameter. The non-autonomy of 'colour' is mirrored in the plethora of psychophysical findings that show that the parameters for internal attributes such as 'depth', 'form', 'texture', 'colour', 'motion' etc. are interlocked in a complex way. This contrasts with standard colorimetric conceptions of 'colour as such' (as also regularly employed in philosophical investigations on colour). Such conceptions, which are derived from common-sense ideas but have no theoretical standing in perception theory, have brought forth spurious artifactual puzzles, as mirrored by the notorious difficulty of colour science to deal with the great variety of 'material colours', such as the appearances of metal, soil, stones, water surfaces, skin etc. The main part of the chapter will therefore be devoted to a treatment of 'material colours'. I will present theoretical and experimental evidence that there is a rich internal conceptual structure pertaining to natural classes of materials (whose complexity has been vastly underestimated in colorimetrically oriented accounts) and to their natural attributes such as wet, hard, juicy, rough, or metallic. This evidence suggests that the internal parameters for 'colour' are intrinsically and inseparably attached to internal concepts for natural classes of materials and their attributes.

12. Don MacLeod, Psychology Department, University of California, San Diego

Abstract: One thing I might be able to do is address the broadest (and correspondingly somewhat well-worn) issues of isomorphism between brain events and color experience, stressing the remarkable and unacknowledged depths of our ignorance about the nature of the correspondence. Such a theme should allow plentiful connections with the writings of Larry and other philosophers, even if those are mostly unknown to me as yet. Although the issue is a very general one, I think there is some scope left for comment from the perspective of a scientific specialist: for instance, the physiological constraint that makes color experience trichromatic is not, I think, well understood.

13. Kathy Mullen, McGill Vision Research, McGill University, Montreal, Canada, and Nicola J.Pitchford, Psychology Department, Nottingham University, UK: From Percepts to Concepts: developmental limits on colour recognition.

Abstract: Since an original description by Charles Darwin about 125 years ago, it has been believed that the comprehension and naming of colours is peculiarly and selectively delayed in development. Darwin informally observed that children failed to identify colours accurately until a surprisingly advanced age, despite the fact that they knew colour words. Modern methods of visual testing have shown that this delay is not due to any perceptual deficit. We therefore ask: if children can see the different colours and know the different colour words, what is preventing them from linking language to percept and accurately identifying their colours? The answer to this question requires an appreciation of the role of cognition in linking our percepts to nameable concepts via the process of categorization.

We will discuss two aspects of this linking process. In the first case, we consider whether there are any perceptual aspects of the different colour categories that may selectively speed or delay their conceptual acquisition. For example, are the primary as opposed to secondary colour categories acquired sooner? Might we expect the recognition of focal as opposed to non-focal colours to develop sooner? We consider these questions as a means of understanding what, if any, perceptual aspects of the stimuli may limit the acquisition of colour recognition. In the second case we consider the general properties of colour as a visual attribute as a possible source of limitations on its development. The postulation that colour cognition develops either 'early' or 'late' implicitly requires a comparison with the development of other perceptual attributes. We will discuss what other visual attributes might occupy a similar cognitive role to colour and discuss the evidence for how they develop conceptually in relation to colour.

14. Reinhard Niederee

15. Jonathan Westphal, Iowa State University: Conflicting appearances, necessity and the irreducibility of propositions about colours

Abstract: This paper begins with Russell's argument that nothing can be ascribed a colour as everything presents conflicting appearances in different illuminations. I argue that there is a unity in the variety of the conflicting appearances brought about by these illuminations. The colour a sample appears is a function of the colour it is and the colour of the illumination; the colour of the sample is the complementary of the colour of the light which the sample refuses to reflect. I end by considering the way in which the resulting defence of colour realism requires the account of necessary truths about colour (e.g. that nothing can be both red and green) given by the so-called "simple view", or primitivism as it is sometimes called, or rather the heterodox version of it for which I argue.

3 Enclosures

We are also enclosing two drafts of essays for the anthology (one from Churchland, one from Cohen) and curriculum vitae for the editors.