COLOR ONTOLOGY AND COLOR SYNESTHESIA

COLOR ONTOLOGY AND COLOR SYNESTHESIA

By JOHN ROMAN, M.A., B.A. Hons.

A Thesis Submitted to the School of Graduate Studies in Partial Fulfillment of the Requirements for the Degree Master of Arts

McMaster University MASTER OF ARTS (2016) Hamilton, Ontario (Philosophy)

TITLE: Color Ontology and Color Synesthesia

AUTHOR: John Roman, M.A. (McMaster University), B.A., Hons. (Western University)

SUPERVISOR: Dr. Barry Allen

NUMBER OF PAGES: vii, 96.

Lay Abstract

Color ontology is the philosophical study of the nature of color. Synesthesia is a neurological condition in which the stimulation of one sensory modality or cognitive pathway leads involuntarily to experiences in a second modality or cognitive pathway. Synesthetic colors are thus colors reliably induced by non-visual stimuli. As it stands, there is no philosophical theory of color that explicitly addresses synesthetic color. Of the current theories in color ontology I argue that only one—perceptual pragmatism—is able to offer a satisfactory account of synesthetic color. However, perceptual pragmatism is also the theory most at odds with common sense. I conclude that if we want a theory that can account for the uncommon colors of synesthesia, we must be willing to reject the common sense view of color.

Abstract

Color ontology is the philosophical study of the nature of color. Synesthesia is a neurological condition in which the stimulation of one sensory modality or cognitive pathway leads involuntarily to experiences in a second modality or cognitive pathway. Synesthetic colors are thus colors reliably induced by non-visual stimuli. Currently, there is no philosophical theory of color that explicitly addresses synesthetic color. This omission raises three questions which underlie this thesis. How would the main theories in color ontology interpret synesthetic colors? Which, if any, of these theories would be able to treat synesthetic color as being more than misperception? What would be the costs of adopting such a theory?

In Part I, I introduce and discuss four prominent theories of color: physicalism (chapter 1), eliminativism (chapter 2), role functionalism (chapter 3), and sensory classificationism (chapter 4). In Part II, I introduce perceptual pragmatism as an alternative to these views. Perceptual pragmatism consists in the defence of two main theses: (i) that colors are properties of interactions between a color perceiver and an external stimulus that induces color experience, and (ii) that perceptual states are correct insofar as they are useful to the perceiving organism. In chapter 5, I defend the first thesis. In chapter 6, I defend the second thesis. In chapter 7, I assess each theory's ability to account for synesthetic color. In chapter 8, I address the common sense objection that colors do not look like properties of events.

In conclusion, I find perceptual pragmatism to be the only theory capable of offering a satisfactory account of synesthetic color. However, it is also the theory most at odds with common sense. I conclude that if we want a theory that can account for the uncommon colors of synesthesia, we must reject the common sense view of color.

Acknowledgments

Thank you to my committee, Dr. Barry Allen and Dr. Sandra Lapointe. Your guidance and critical comments have been essential to this thesis.

Excerpts of this thesis were presented at Cambridge University, Western University, and UNC-Asheville. I am very grateful to these audiences for their feedback and engagement. Special thanks go to Dr. Mazviita Chirimuuta for reading and commenting on an excerpt of this thesis.

Thank you to the McMaster Department of Philosophy. Your assistance and support throughout my time in the program have been invaluable.

Table of Contents

PART II. PERCEPTUAL PRAGMATISM

Introduction

Color has a special place in the philosophy of mind and metaphysics. In the work of Bertrand Russell, Ludwig Wittgenstein, J. L. Austin, Wilfrid Sellars, D. M. Armstrong, J. J. C. Smart, and Frank Jackson, we find color at the centre of discussions of perception, often serving as the inspiration for some of analytic philosophy's most enduring examples. Considered in isolation, color ontology may seem like a minor and specialist field; its implications, however, are not. What one says of color largely determines what one can say of the other sensible properties and of perception in general. Color is often seen as a first test, an experimental site, from which a richer philosophy of perception can be built. This is how I approach color ontology in this thesis: as a vivid diagnostic for a general theory of perception.

This project is primarily motivated by an issue largely ignored in color ontology: color synesthesia. Synesthesia is a neurological condition in which the stimulation of one sensory modality or cognitive pathway leads involuntarily to experiences in a second modality or cognitive pathway. Synesthetic colors are thus colors that are reliably induced by non-visual stimuli. The omission of synesthesia from color ontology raises three broad questions which underlie this thesis. How would the main theories in color ontology interpret synesthetic colors? Which, if any, of these theories would be able to treat synesthetic color as being more than misperception? What would be the costs of adopting such a theory?

In Part I, I introduce four prominent theories in color ontology: physicalism (chapter 1), eliminativism (chapter 2), role functionalism (chapter 3), and sensory classificationism (chapter 4). I outline their motivations and criticisms in regard to six

main issues: phenomenology, perceptual variation, common sense, disagreement, illusion, and the usefulness of color vision. Physicalism—the view that colors can be identified with physical properties—accommodates the common sense view that objects are colored and provides us with an objective standard for adjudicating perceptual disagreements, but it encounters difficulty in accounting for aspects of phenomenology (i.e., the unique-binary hue distinction and resemblance relations) and perceptual variation. Eliminativism—the view that colors do not exist—accommodates these aspects of phenomenology and perceptual variation, but defies common sense, forfeits an objective standard for determining the truth and falsity of color judgments, and makes the usefulness of color vision difficult to explain. Role functionalism—the view that colors are role functional properties that dispose their bearers to appear colored to certain perceivers under certain circumstances—advances on most of these issues, with the exception of usefulness. Sensory classificationism—the view that colors are classes of distal stimuli relativized to the classificatory scheme of the perceiver's sensory system—seems able to respond to all six issues, but its account of perceptual error prevents it from offering a satisfactory account of color synesthesia.

In Part II, I introduce Mazviita Chirimuuta's perceptual pragmatism as an alternative to these views. Perceptual pragmatism consists in the defence of two main theses: (i) that colors are properties of interactions between a color perceiver and an external stimulus that induces color experience, and (ii) that perceptual states are correct insofar as they are useful to the perceiving organism. In chapter 5, I introduce the first thesis and respond to some initials criticisms concerning perceiver-dependence,

predication, and phenomenology. In chapter 6, I introduce the second thesis and show how it responds to issues of perceptual variation, disagreement, and illusion.

In chapter 7, I assess each theory's ability to account for synesthetic color. As it stands, no theory of color, including Chirimuuta's, explicitly addresses synesthesia. I argue that perceptual pragmatism is the only theory capable of affirming the reality of synesthetic color, distinguishing synesthetic color from normal color, and avoiding the ontological excess of ascribing synesthetic color properties to external objects. I argue that this distinct ability is due to perceptual pragmatism's commitment to its two main theses. The first thesis—that colors are properties of events—avoids the problems associated with treating synesthetic colors as properties of objects. The second thesis—that perceptual states are correct insofar as they are useful to the perceiver—allows for the recognition of synesthetic color as being more than misperception. I also revisit criticisms introduced in chapter 5 and argue that these proposed points of weakness in Chirimuuta's theory are in fact strengths once synesthetic color is considered.

In chapter 8, I address the common sense objection that colors do not look like properties of events. In response, I attempt to unsettle the objector's conviction by offering examples from ordinary phenomenology and arguing that phenomenology is agnostic as to whether colors appear as properties of individuals or events. I also argue that adopting a theory in which colors are properties of events dissolves certain philosophical difficulties associated with chromatic adaptation and after-imaging.

In conclusion, I find perceptual pragmatism the only theory capable of offering a satisfactory account of synesthetic color. However, it is also the theory most at odds with common sense. To accept the perceptual pragmatist view that colors are properties of

interactions is to reject the common sense view that colors are intrinsic, non-relational properties of objects. These two claims cannot be reconciled. This is no small sacrifice given that most of our conceptual practices involving color rely on the common sense view. I conclude that if we want a theory that can account for the uncommon colors of synesthesia, we must be willing to reject the common sense view.

PART I. FOUR THEORIES OF COLOR

On the question of color's reality, there are two broad lines of thought: realism and eliminativism. Realists argue that colors exist. Eliminativists argue that they do not. In this section, I discuss eliminativism (Averill 2005; Pautz 2006; Maund 2011) and three forms of realism—physicalism (Tye 1995; Lewis 1997; Byrne & Hilbert 2003a), role functionalism (Cohen 2009), and sensory classificationism (Matthen 2005)—in relation to six main issues: phenomenology, perceptual variation, common sense, disagreement, illusion, and the usefulness of color vision.

Physicalism excels with regard to common sense, disagreement, illusion, and usefulness, but encounters difficulties in accounting for the structure of phenomenal color and perceptual variation. Eliminativism does the exact opposite. Role functionalism seems capable of responding to all issues except usefulness (and, arguably, common sense). Sensory classificationism scores well on all six issues, but I argue that its account of perceptual function and error is unable to make sense of the abnormal but useful colors of color synesthesia.

1. Physicalism

Physicalism is the view that colors are physical properties. Since colors are constituents of the physical world independent of color-perceiving organisms, the physicalist argues, colors are real. Most physicalists argue that colors are identical to *spectral surface reflectances*. A reflectance is the proportion of light an object is disposed to reflect (rather than absorb or transmit). A spectral surface reflectance (SSR) is an ordered triple of the proportion of light an object is disposed to reflect for the light sensitivity range of each of the human visual system's three cone types (long-wave (580nm), middle-wave (540nm), and short-wave (440nm)). Since phenomenal colors are the result of combinations of output signals from these three cone types, each perceivable color for normal human perceivers seems, at least in principle, identifiable with a certain SSR.

This approach is clear in Lewis (1997), who offers an initial folk-theoretic definition of red as "the surface property of things which typically causes experience of red in people who have such things before their eyes" (Lewis 1997, 327), followed by the claim that if the surface property responsible for red experience is a certain reflectance, then red *is* that reflectance property. We also find a similar set of claims in Tye (1995). First, he makes the common-sense statement that "colors are objective, physical features of objects and surfaces," and then he proposes that "the colors themselves may be identified with ordered triples of spectral reflectances" (Tye 1995, 150). This view also appears in Byrne and Hilbert (2003a), who state that "physical objects (for instance,

tomatoes, radishes, and rubies) are colored, and that colors are physical properties, specifically, types of reflectance" (Byrne & Hilbert 2003a, 3). [1]

1.1. Motivations

1.1.1. Common sense

Physicalism is an attempt to preserve the common sense notion that physical things are colored. For example, Lewis (1997) argues that an adequate theory of color "must be both materialistic and commonsensical," the former demand being non-negotiable, the latter flexible to some degree (Lewis 1997, 325). Lewis sees the eliminativist view as being at odds with common-sense beliefs: "It won't do to say that colours do not exist; or that we are unable to detect them; or that they never are properties of material things; or that they go away when things are unilluminated or unobserved" (Lewis 1997, 325). To each of these weaknesses in eliminativism, the physicalist can offer an alternative. By identifying surface color with objective properties, the physicalist is able to say all of the following: (a) colors exist; (b) we are able to detect them; (c) they are properties of material things; and (d) they still exist when unilluminated or unobserved. According to Lewis, if a theory compromises on any of these points, "it becomes doubtful whether the so-called 'colours' posited in your theory are rightly so-called" (Lewis 1997, 325).

Physicalism also offers a clear account of color constancy. Color constancy refers to the fact that we perceive objects as having stable colors under various perceptual

[1] To be more precise, Byrne & Hilbert (2003a) identify colors with *productances*: that is, a "surface's disposition to produce (i.e., reflect or emit or transmit) a specific proportion of incident light" (Byrne & Hilbert 2003a, 11). Whereas reflectance concerns only the light an object *reflects*, productance includes any way light leaves an object (i.e., whether reflected, transmitted, or emitted).

circumstances. For example, a book's pages appear white to me whether seen under lamplight, candlelight, or sunlight. By identifying colors with illumination-independent objective properties, the physicalist can explain this phenomenon by claiming that an object appears stably colored under various perceptual circumstances because its spectral surface reflectance (i.e., its disposition to reflect incident light) remains constant despite environmental changes (e.g., to the illuminant or viewing angle).

1.1.2. Disagreement and illusion

Since colors are identical to objective properties, the physicalist has clear criteria for adjudicating cases of perceptual disagreement. Suppose two normal perceivers are presented with two red color chips, asked to pick the one that is *unique red* (that is, a red which contains no other hue), and find that they disagree (a common variation among normal perceivers; cf. Malkoc et al. 2005). The eliminativist, denying that color is identifiable with an objective property, must claim that both perceivers are wrong: neither chip is unique red because colors do not exist. However, if unique red is identical to a spectral surface reflectance property, call it $SSR_{UNIQUE\text{-}RED}$, then we can look at the two selected chips and determine which bears the property $SSR_{UNIQUE\text{-}RED}$. The perceiver who has selected the chip with the correct reflectance property will be right, and the other perceiver wrong.

The reduction of colors to physical properties also helps to account for cases of perceptual illusion. Consider the standard example of a surround-contrast illusion. Two grey patches with identical SSRs are each placed within a differently colored surround: one black, one white. For most perceivers, the grey patch surrounded by black will appear lighter, while the grey patch surrounded by white will appear darker. If we take

color experience as our starting point, as the eliminativist does, then this presents a problem: if the two patches appear differently colored, are they in fact two different colors? The physicalist, in identifying color with reflectance, does not face this problem. Since both patches have the same reflectance properties, the two patches are the same color regardless of perceptual circumstance.

1.2. Criticisms

1.2.1. Phenomenology

In our common sense understanding of color, there are certain claims we take to be basic truths about the colors and their relations, e.g., that *orange* is a mixture of *red* and *yellow*, or that *blue* looks more like *purple* than *green*. The former example involves a claim about the unique-binary hue distinction. A unique hue is a hue that appears to contain no other hue. There are four unique hues in human color vision: red, green, yellow, and blue. A *binary hue* is a hue that appears as a mixture of two unique hues. Binary hues include orange, purple, cyan, and lime. When I say, "Orange is made up of red and yellow," I mean that orange, a binary hue, is composed of the unique hues red and yellow, that is, that orange is reddish-yellowish. The latter example involves a *resemblance* relation which relies on the unique-binary distinction. Blue resembles purple more than green because purple is a binary hue with blue and red as its constituents, whereas green, being a unique hue, is not constituted by other hues. When I say, "Blue resembles purple more than green," I mean that a relation obtains between blue and purple that does not obtain between blue and green.

A popular eliminativist argument against physicalism is to argue that the reduction of colors to spectral surface reflectances cannot account for these facts (Hardin

1988; Maund 1995; Thompson 1995; Pautz 2006). Recall that, according to physicalism, each color is identical to a certain SSR. So, red is identical to a certain ordered triple of reflectances (SSR_{RED}), as is yellow (SSR_{YELLOW}), orange (SSR_{ORANGE}), and so on. Thus, the sentence "The ball is red" is true iff the ball bears the property SSR_{RED}. Now, suppose a perceiver makes the claim "Orange is a mixture of red and yellow." If each color is identical to a certain SSR, then this claim will be true iff SSR_{ORANGE} is a mixture of SSR_{RED} and SSR_{YELLOW}. But there is no clear sense in which SSR_{ORANGE}, an ordered triple of reflectances, is a mixture of SSR_{RED} and SSR_{YELLOW}. So, if we adhere to the physicalist reduction, the claim "Orange is a mixture of red and yellow" is false. But the claim "Orange is a mixture of red and yellow" is a basic truth about color. Therefore, physicalism must be wrong.

A similar argument can be made for resemblance claims. According to the physicalist, the claim "Blue resembles purple more than green" will be true iff SSR_{BLUE} resembles SSR_{PURPLE} more than SSR_{GREEN}. But there is no clear sense in which SSR_{BLUE} resembles SSR_{PURPLE} more than SSR_{GREEN}. So, if we adhere to the physicalist reduction, the claim "Blue resembles purple more than green" is false. But the claim "Blue resembles purple more than green" is true. Therefore, physicalism must be wrong.

There are a few strategies for response here. One strategy is to argue that the unique-binary distinction and resemblance relations are not facts given in color experience. For example, Tye (1995) suggests that facts deriving from the binary-unique distinction "are arguably facts we have learned through training, not facts given to us in our color experiences and extractable from them without any basic lessons or art classes on the various colors and their relationships" (Tye 1995, 148). If this were true, then one

could maintain that colors are objective properties, but deny that binary-unique relations are objective features of colors. However, denying that orange looks like a mixture of red and yellow, or that blue looks more like purple than green, seems to exclude essential features of our common sense view of color. Given that physicalism is largely driven by its ability to preserve common sense, suggesting that that unique-binary and resemblance relation claims are false would seem to be an unsatisfactory conclusion.

A second strategy is to accept these facts as true and show how they can be accommodated within a physicalist theory. Byrne and Hilbert (2003a) propose that physicalism can be reconciled with the facts of color structure if we adopt an account in which "visual experience represents objects as having *proportions of hue-magnitudes*" (Byrne & Hilbert 2003a, 14). This proposal is best explained by analogy. Suppose we have a rectangle, *a*, whose length is one metre and whose width is four metres. *Length* and *width* are magnitudes, and the values of these magnitudes for this particular rectangle are one and four, respectively. Call the sum of a rectangle's length and width its *size*. In this example, the rectangle's *size* will be five metres. Therefore, we can say that "*a*'s length is 20% of its size," or that "*a*'s width is 80% of its size." Similarly, suppose we have an orange object—that is, an object that appears in roughly equal parts yellowish and reddish, and neither greenish nor bluish. *Yellowness*, *redness*, *greenness*, and *blueness* will be our hue-magnitudes, and for this particular object, *yellowness* and *redness* will have the same positive value, while *greenness* and *blueness* will have no value. Call the sum of the values of an object's hue-magnitudes its *total hue*. For this particular object, redness is 50% of total hue, yellowness, 50%, and both greenness and blueness, 0%.

If hue-magnitudes are reducible to reflectance-types, as Byrne and Hilbert believe they are, the physicalist can offer an account of the binary-unique distinction and resemblances claims while maintaining that colors are physical properties. Orange appears as a mixture of yellow and red because orange objects are represented as having a roughly equal proportion of the hue-magnitudes *yellowness* and *redness*. Blue resembles purple more than green because blue objects are represented as having a high proportion of the hue-magnitude *blueness*, purple objects are represented as having a roughly equal proportion of the hue-magnitudes *blueness* and *redness*, and green objects are represented as having, at most, a low proportion of the hue-magnitude *blueness* relative to its high proportion of *greenness*.

However, it's not clear that Byrne and Hilbert's hue-magnitude account adequately answers the phenomenological objection for at least two reasons. First, Byrne and Hilbert suppose that hue-magnitudes can be reduced to certain reflectance-types, but they do not clearly define the four hue-magnitudes in terms of SSRs. They give a rough-and-ready description of how this could be done for *redness* only, but they do not identify the hue-magnitudes with specific reflectance-types. In their response to the peer commentary on the article, they acknowledge that their account "was *not* any kind of definition of the hue magnitudes, even given the assumption of physicalism" (Byrne & Hilbert 2003b, 55). This isn't to say that hue-magnitudes are not reducible to reflectance-types, but it may be a more difficult procedure than Byrne and Hilbert suppose.[2]

Second, Byrne and Hilbert's suggestion for how hue-magnitudes can be reduced to reflectance-types involves determining which reflectance-types produce the relevant

[2] See Pautz (2003) and Allen (2015) for criticisms regarding the empirical adequacy of Byrne and Hilbert's hue-magnitudes proposal.

cone responses in the human visual system associated with the four unique hues. The significance of this point requires some explanation. As mentioned earlier, there are three cone types in the human eye, each sensitive to a different part of the spectrum. Call the cones sensitive to longer waves *L-cones*, middle-waves, *M-cones*, and shorter waves, *S-cones*. According to opponent processing theory, the outputs of these three cone types interact to produce three new signals to be sent to the brain: two chromatic and one achromatic. Outputs of the L-cones and M-cones are differenced to generate the *red-green signal*. If the difference is positive, the signal codes redness; if negative, the signal codes greenness. The summed output of the L-cones and M-cones is differenced with the S-cones output to yield the *yellow-blue channel*. If the sum is positive, the signal codes yellowness; if negative, the signal codes blueness. Outputs of the L-cones and M-cones are summed to generate the *achromatic signal*. Strictly speaking, this signal is known as the "whiteness response," since negative values (blackness) can only be produced via contrast and not in isolated light spots.[3] Thus, Byrne and Hilbert suggest that an object has some value of the hue-magnitude *redness* if it reflects light in such a way that it stimulates a standard human perceiver's L-cones more than her M-cones (the greater the difference, the greater the value of the hue-magnitude redness).

[3] Unlike whiteness or unique hues, blackness cannot be produced by direct light stimulation; rather it is the result of contrast or compensation to white light stimulation (Hurvich 1981, 61). In order to be seen, black requires a lighter color present in the same scene or closely prior in time. In other words, black is not a distinct color nor the absence of light, as is often thought, but the result of a contrast between lightness and darkness. You can walk *into* a pitch-black room coming from a lighted environment, but shortly after, lacking a lighter color against which to contrast, the room will appear grey as activity in the whiteness signal settles back to a neutral state. You might see a black square *within* a white surround, but if you look at the same square through an aperture (so that only the square is visible), it too will soon appear grey.

However, if hue-magnitudes are defined in terms of the cone responses, it is unclear in what sense hue-magnitudes are perceiver-independent. Recall that the physicalist is not claiming that colors exist relative to human perceivers, but that colors exist independently of perceivers. We can imagine a possible world in which the human visual processing is such that different reflectance-types are associated with different cone responses. If hue-magnitudes are defined in terms of cone responses, then it is possible that certain hue-magnitudes that exist in this world may not exist at other worlds. The hue-magnitude proposal also faces the problem of determining a standard observer on which to base the identities of hue-magnitudes with reflectance-types, a worry which I address in the following section.

1.2.2. Perceptual variation

Physicalists believe that colors are perceiver-independent, physical properties. With regard to perceptual disagreement, the reduction seems advantageous as it provides us with an objective standard for adjudicating perceptual disagreements. However, determining objective physical identities with the colors is no easy task.

First, there is the problem of establishing a standard observer. Given that scientific investigations into the physical properties identical to the colors necessarily involve a subjective, psychological component, the identification of colors with objective properties is inherently approximate. Identifying colors with SSRs—for example, unique red (a red containing no other hue) with $SSR_{UNIQUE\text{-}RED}$—relies on a hypothetical standard observer. The standard observer is a statistical construct based on a sample of the general population to represent an average human perceiver. But there is a difference between an average perceiver and an objective perceiver. The physicalist is not making the modest

claim that $SSR_{UNIQUE\text{-}RED}$ is the physical property involved in an average human perceiver's perception of unique red, but that $SSR_{UNIQUE\text{-}RED}$ is *really* unique red in an objective, perceiver-independent sense.

Second, physicalism neglects interspecies variation. Even if we could establish an standard observer for human color perception, identifying colors with the physical properties involved in human color vision would exclude many other species from perceiving real colors. If colors are reflectances, then only those perceivers whose visual systems detect spectral surface reflectance properties in color perception actually perceive color. If SSR_{RED} is identical to red, then only those perceivers whose visual system detects SSR_{RED} actually perceive red. But species differ in color dimensionality and spectrum sensitivities. Human color perception involves four unique hues (red, green, blue, and yellow), while the visual systems of other species may involve two (e.g., rabbits and squirrels), six (e.g., goldfish and turtles), or eight (e.g., pigeons and ducks) (Thompson et al. 1998, 371). Because all hues are reducible to combinations of unique hues, the number of a perceiver's unique hues will alter the number of perceivable colors and the relations between colors. Human perceivers see unique hues and binary hues, but goldfish may see ternary hues, and pigeons, quaternary hues. In addition, there are also variations among animals with the same color dimensionality. For example, humans and honey bees perceive four unique hues, but the bee's color vision is more sensitive to the ultraviolet range of the light spectrum (Thompson et al. 1998, 327). This means that a wavelength that humans would ordinarily perceive as purple, the bee might perceive as blue. Therefore, it is unlikely that SSR_{RED} picks out the physical property corresponding to phenomenal redness across all species.

When we consider the extent of this variation, it seems arbitrary to say that humans perceive colors, while bees or pigeons do not. If we identify colors with only those physical properties involved in human color vision, we might be able to settle disagreements between human perceivers, but at the cost of denying that certain other species perceive real colors. For physicalists who approach color in a narrowly anthropocentric sense, like Hilbert (1987), this may not be a concern, but for realists who desire a more ecological approach, like Matthen (2005), this requires some theoretical accommodation.

2. Eliminativism

Eliminativism is the view that there are no colors in the perceiver-independent world. Colors cannot be identified with objective properties, and, so, objects are not colored. Therefore, it is, strictly speaking, false to attribute colors to objects.

The main motivations for eliminativism mirror the criticisms of physicalism, and it is in the difficulty of accommodating color properties within a physicalist ontology that eliminativism's appeal mainly resides. As Edward Averill remarks, "the nature of these properties is obscure. It is not at all clear how they fit into a naturalistic account of things, or even what sorts of objects, if any, are colored." (Averill 2005). If there is no physical property that is both common to all human and non-human perceivers in color perception and that can account for unique-binary and resemblance relations, then colors, the eliminativist argues, must not be part of the perceiver-independent world.

By denying the reality of colors, the eliminativist can maintain both (i) that no perceiver, nor species, has privileged access to real colors, and (ii) that claims about binary-unique and resemblance relations are true. However, this ability comes at the price of denying the common sense view that objects are colored, forfeiting an objective standard for adjudicating perceptual disagreement and illusion, and introducing the puzzle of how non-existent colors prove useful for interacting with the real world.

2.1. Motivations

2.1 1. Phenomenology

As discussed in the previous chapter, it seems difficult, if not impossible, for the physicalist to account for unique-binary and resemblance relations between the colors. If

we take the unique-binary distinction and resemblance relations as basic truths about color and we find that no physicalist reduction can account for them, then physicalism must be mistaken. Eliminativists, like Pautz (2006), often take the argument from color structure as support for the claim that colors do not exist in the external world. First, he claims that "colours are primitive properties and claims about colour structure report primitive facts about them" (Pautz 2006, 536). And since no physical property can account for these facts, namely, the unique-binary hue distinction and resemblance relations, Pautz argues that we should be eliminativists about color. "We experience these properties as instantiated in physical space. But they are not instantiated by anything, including our own experiences. Therefore there are no coloured *things*" (Pautz 2006, 562). Here, the advantage of adopting eliminativism is evident: take color out of the world and we avoid the problem of finding physical properties whose relations are isomorphic to those of the colors.

2.1.2. Perceptual variation

Color perception varies between perceivers and species. Normal human perceivers differ in fine-grain color perception (Malkoc et al. 2005). Species differ in spectral sensitivity and number of unique hues (Thompson et al. 1998). There appears to be no non-arbitrary way of choosing an ideal perceiver or species on which to base our identifications of colors with perceiver-independent, physical properties. As Charles Landesman remarks, in discussing interspecies variation, "there is no question here of who is right and wrong. Their visual system supplies indicators useful to them; ours supplies indicators that are useful to us" (Landesman 1993, 122). By denying that there are real colors out there in the external world, the eliminativist avoids the problem of

specifying an ideal perceiver who has privileged access to them. Human colors are useful for human activities, pigeon colors are useful for pigeon activities, but no one species or perceivers sees 'real' color in the objective, perceiver-independent sense, because such colors do not exist.

2.2. Criticisms

While eliminativism can accommodate issues of color structure and perceptual variation, many commentators believe that its denial of color's reality is too strong and defies common sense. How eliminativism defies common sense is obvious enough: objects look colored, and eliminativists claim that nothing is colored. Although this might seem to be an acceptable conclusion to draw from the above arguments, when we deny that colors exist, we encounter difficulty in accounting for the usefulness of color vision, perceptual error, and disagreement.

Boghossian and Velleman (1997) identify two major concerns for eliminativism. First: if colors are not part of reality, then how do we account for the usefulness of color vision and color concepts? Second: if all our attributions of colors to objects are false, then how do we distinguish between correct and incorrect color judgments? (Boghossian & Velleman 1997, 98).

2.2.1. Usefulness

In response to the first concern, Boghossian and Velleman, defenders of the eliminativist view, remark that color terms are just one example of the many harmless falsehoods in ordinary language. For example, consider the term 'sunrises.' The Sun doesn't actually rise upon the face of the Earth; rather, the Earth's horizon falls in its

rotation, making the Sun visible. It may be more accurate to speak of 'horizon-falls,' but this would be more misleading and cumbersome than using 'sunrises.' Similarly, true conclusions are more easily drawn "from the familiar false picture of colours than they would be—by the ordinary person, at least—from the true picture of wavelengths and spectral-reflectance curves" (Boghossian & Velleman 1997, 100). For most tasks, the coarse-grained color categories (e.g., red, yellow, orange, etc.) are all we need. They allow us to identify and talk about objects, to classify objects, and to inductively reason about their properties (e.g., a fruit's color as indicating its ripeness).

One strategy for reconciling the usefulness of colors with their unreality is to treat colors as fictional properties, that is, as properties that are not real, but which prove useful when we 'make-believe' that they are. Barry Maund, for example, takes a fictionalist approach to color, in which colors are properties "that objects might have but do not, a property that in some possible world they have, but not in this one" (Maund 1995, 36). In his view, we act on and talk about the colors of objects *as if* they actually possessed them, and we "'make-believe' that the ordinary colour sentences are true—at least for very many contexts" (Maund 2011, 362). Treating objects as having the colors they appear to have enables us to engage in "a vast range of conceptual practices," such as object recognition and classification (Maund 2011, 382). So, while the sentence "Tomatoes are red" is literally false, it is acceptable within the context of the non-philosophical, folk game of make-believe in which colors are properties of objects.

However, color fictionalism falls prey to the many of the same criticisms leveled against other forms fictionalism, whether of possible worlds, numbers, or morals. First, the sense in which colors are fictional is obscure. Unlike paradigm fictional entities, like

characters in a novel, there seems to be no plausible interpretation in which colors are artifacts whose existence depends on an author. If Arthur Conan Doyle did not create Sherlock Holmes, there would be no Sherlock Holmes. But colors are not consciously invented in this way. We see things as colored without an intentional effort to do so, and we interact with colored things and engage in conceptual practices involving colors with little instruction or confusion. Second, the sense in which pretending objects are colored is a game of make-believe is obscure. Unlike ordinary games of make-believe, like pretending a hobbyhorse is a real horse, pretending colors are objective properties is a lifelong game, played mainly by individuals who are unaware they're playing a game. Third, interpreting colors as fictional properties seems only to rephrase the problem of accounting for color's usefulness. Now, the question becomes: how is it that fictional entities and the games of make-believe in which they feature enable effective environmental interactions? Fictionalism does not explain the relationship of colors to world, nor why colors, when treated as properties of objects, prove useful in our interactions with our environment.

2.2.1. Disagreement and illusion

In response to the second concern, Boghossian and Velleman draw a distinction between "standard" and "non-standard" colors. Ordinary speakers often distinguish between the color an object *really* has and the color an object *seems* to have. A piece of printer paper is *really* white, but when taken inside a photographer's dark room it may *seem* red. Boghossian and Velleman argue that "classifying an object by the color it appears to have under so-called standard conditions is the most reliable and most informative way of classifying it" (Boghossian & Velleman 1997, 100). So, despite the

fact that colors do not exist, some colors, those seen under "standard" conditions, are more reliable and more informative. Therefore, if two speakers disagree about an object's color, we might say that the person whose judgment most closely corresponds to the object's standard color is correct (in some sense), but that both judgments are, strictly speaking, false, because colors are not properties of objects.

However, determining an object's standard color is no easy task and problem cases abound. Boghossian and Velleman consider a hypothetical case in which two objects look similarly colored under daylight conditions but differently colored under incandescent light. In their example, the first object appears green in daylight and incandescent light, while the second object appears green in daylight but brown in incandescent light. If most objects that appear green under daylight also appear green under incandescent light, do we say that the second object's standard color is green, brown, or can we even say it has a 'real' color at all? Boghossian and Velleman respond that at this point "intuitions diverge and ultimately give out" (Boghossian & Velleman 1997, 101). But the fact that there is no clear method for determining an object's standard color may be taken as support rather than criticism for eliminativism. If objects aren't really colored, then it shouldn't surprise us that the task of assigning objects standard colors will be, at best, an approximate and pragmatic endeavor.

3. Role Functionalism

In *The Red and the Real* (2009), Jonathan Cohen offers two compatible answers to the question of what kinds of properties colors are. First, he says, colors are *relational* properties, that is, properties constituted in terms of relations between perceivers and perceptual circumstances; and, second, that these relational properties are best understood as *functional roles*, that is, "relations involving the performance of a certain functional role that connects surfaces, light, and the like, to visual systems" (Cohen 2009, 177). In Cohen's role functionalist view, the color red is the property of *looking red* to subject *S* in perceptual circumstance *C*; and *red for S in C* is the functional role that disposes the objects that bear it to look red to *S* in *C*. In other words, a color is a property that when possessed by an object disposes that object to appear a certain way to certain perceivers under certain circumstances.

If role functionalism sounds similar to Lockean dispositionalism, that's because in many ways it is (a fact which Cohen acknowledges (Cohen 2009, 220)). Recall Locke's definition of secondary qualities as "nothing in the objects themselves, but powers to produce various sensations in us by their primary qualities" (Locke 1689/1975, II, 8, §10). In both Locke and Cohen, colors are similarly understood as second-order properties realized by first-order properties; however, the accounts differ in their conception of dispositions and their conclusion on the ontological status of color. For Cohen, dispositions are functional roles. If an object possesses the functional role *red for S in C*, then red is instantiated in the world (Cohen 2009, 180). In contrast to Locke, the reality of colors is not perceiver- or circumstance-dependent. The existence of some perceiving subject *S* or some viewing circumstance *C* is irrelevant to the color's

existence. There may be no one in the room, there may be no light in the room, and yet an apple's redness will remain in existence as long as the object remains disposed to *look red* if someone were to enter the room and turn on the lights.

3.1. Motivations

The motivation for role functionalism begins with accounting for the platitude that "certain objects are disposed to look colored to subjects" (Cohen 2009, 180). The red apple before me has a disposition to look red to me; it produces in me a visual experience of looking red. From this observation it is sensible to suppose that (i) color properties, if they exist, cause particular visual experiences in certain subjects under certain circumstances, and (ii) the objects bearing color properties are disposed to cause these particular visual experiences in certain subjects under certain circumstances. By treating color as a relational property, role functionalism is able to account for the structure of phenomenal color and perceptual variation without accepting the eliminative conclusion that nothing is colored.

3.1.1. Phenomenology

Colors, being functional roles, can be realized by different physical properties. Unlike physicalism, which identifies color with a specific kind of physical property (e.g., spectral surface reflectance), role functionalism "leaves it open that there may be many distinct structures that count as realizers of *red for S in C* within world *w*; this will happen if the different structures all realize the functional role of disposing their bearers to look red in *w*" (Cohen 2009, 180). By remaining agnostic on what realizes these functional roles, Cohen can avoid the physicalist's worries of color structure. Since Cohen does not identify color with a physical property, e.g., spectral surface reflectance,

he is not responsible for finding a physical property that accounts for the unique-binary distinction and resemblance relations. Whatever occupies the role *purple for S in C* preserves the fact that purple is a mixture of red and blue and the fact that purple resembles blue more than green.

3.1.2. Disagreement and perceptual variation

In a case of perceptual disagreement between two perceivers, S_1 and S_2, there are four available responses: (a) S_1 is correct, S_2 is wrong; (b) S_1 is wrong, S_2 is correct; (c) neither S_1 nor S_2 is correct; (d) both S_1 and S_2 are correct. In claiming that nothing is truly colored and that our attribution of colors to objects is false, the eliminativist is committed to (c): neither perceiver is correct. In identifying colors with objective properties, the physicalist has definite criteria for adjudicating cases of perceptual disagreement and is therefore committed to either (a) or (b): one or the other perceiver is correct. Cohen, on the other hand, in defining color as relative to certain perceivers in certain circumstances (e.g., *red for S in C*) is committed to (d): both perceivers are correct.

There are a few reasons that motivate Cohen's relativism. He sees the eliminativist conclusion that all color judgments are false as unacceptably skeptical and revisionary. He writes that this conclusion "flies in the face of naïve belief" and ignores the fact that "we learn something about the world when we visually perceive the colors of … objects" (Cohen 2009, 65). He also sees the physicalist view that one or the other perceiver is correct as unacceptably arbitrary. If we define color only in terms of human perceivers, we claim that the human visual system is the only visual system capable of perceiving correctly. But, as previously discussed, it seems arbitrary to prefer human color vision over that of other species. By relativizing color, Cohen is able to affirm

color's reality while avoiding the problem of establishing a non-arbitrary objective standard for color judgments. I think the relativist conclusion is the right one to draw given the problems that plague the other two options, but I find Cohen's relativism lacking in specificity and in need of supplementation. I revisit this point in 3.2.2.

3.2. Criticisms

3.2.1. Common Sense

In the common sense view of color, colors are non-relational, intrinsic properties of objects (Tye 1995; McGinn 1996; Chalmers 2006; Maund 2011). As Tye observes, when one looks at a tomato, visual experience presents the tomato's redness as "intrinsic to [its] surface" (Tye 1995, 145). Redness is a property of the tomato, not a relational property involving a perceiver, as Cohen argues. If colors are relational but visual experience presents them as non-relational, then we systematically misperceive the true nature of color. However, if colors are non-relational, there is no such conflict. Given the non-relationality of color in ordinary phenomenology and the importance of ordinary phenomenology to an adequate theory of color, Tye argues that the view that colors are relations is "just not credible" (Tye 1995, 145).

McGinn (1996) presents what is often taken as the standard form of the common sense objection to relational theories of color. McGinn claims that much like shape and size, color is perceived as (i) "intrinsic to the object," (ii) "wholly *on* the object, not as somehow straddling the gap between it and the perceiver," (iii) delimited to the object's spatial boundaries, and (iv) phenomenally different from paradigm relational properties such as *larger than* or *to the left of* (McGinn 1996, 541-542). Therefore, McGinn argues, if colors were in fact relational, then color vision would be guilty of widespread and

systematic error. However, we do not have reason to think that color vision is guilty of widespread error, so colors must not be relations.

McGinn's argument rests on the putative phenomenological fact that visual experience presents colors as non-relational properties. However, I think we have good reason to reject this premise. First, there are many instances in ordinary phenomenology where color does not appear as intrinsic to the object. Second, McGinn's criteria for what a relational property would look like are unnecessarily narrow and unreflective of visual experience. The purpose of my response in defence of Cohen is not to argue that phenomenology presents colors as relational, but to unsettle the objector's conviction that visual experience presents colors as unambiguously non-relational. If this can be done, then we can block McGinn's version of the relational objection before it starts.

In McGinn's view, colors look non-relational primarily because visual experience presents them as being intrinsic to their objects. In many cases, this is true: a tomato's redness appears like a property of the tomato, a wooden desk's brownness appears like a property of the desk. In these cases, the apparent color is delimited by the object's boundaries, is wholly on the object, and remains relatively constant as changes are made to the illuminant and the perceiver's viewing angle. However, there are numerous examples in ordinary visual experience where color does not appear this way: the shimmering play of color on the back of a CD or a hologram baseball card, the iridescent sparkle of diamonds and crystals, the swirling rainbows on the surface of bubbles or wet pavement streaked with oil. There's an evident phenomenal distinction between these 'unsteady' colors and the 'steady' colors of a red tomato or brown desk. Adjust your

viewing position or the light source and the colors on the back of a CD shimmer and change. Do the same with a tomato and its redness appears relatively unaltered.

As Mark Johnston observes, in ordinary phenomenology unsteady colors "appear as relational qualities" and visual experience "reveals their dependence on the perceiver's position and the light source" (Johnston 1997, 141). By adjusting one's viewing position and the light source while observing the changes in color from moment to moment, the relational nature of unsteady colors is revealed to the perceiver. A comparative element is thus necessary to reveal the relationality of color: seeing color as relational in these cases requires movement (of perceiver or light source) and comparison between moments. If we conceive of color phenomenology in narrowly 'photographic' terms—that is, as isolated moments, as pictures of visual scenes rather than perceiving events—then even the unsteady colors of a CD would appear steady and non-relational. In other words, if we allow comparison to be considered part of phenomenology, then it is possible for certain colors to appear relational. However, if we exclude comparison from phenomenology, then it is not possible for color to appear relational. As Cohen remarks, this "narrower brand of phenomenology won't reveal colors as relational – but that is only because it is unsuited to discovery of relationality where it exists at all" (Cohen 2009, 160). Determining whether a sensible property is relational depends on comparison of phenomena, something that the isolated moments of the narrower, 'photographic' conception of phenomenology simply cannot provide.

One might object that admitting comparison into phenomenology adds an inferential element unbefitting raw phenomenology. But for Cohen's purposes, it's irrelevant whether the relationality of color is apparent in phenomenology or requires an

extra inferential step. In either case the original premise of the objection—that colors appear non-relational in visual experience—cannot be established. If one allows comparison in phenomenology, then some colors appear relational in visual experience (e.g., the unsteady colors of CDs and holograms), and therefore the universal claim that colors appear non-relational in visual experience cannot be established. If, on the other hand, one does not allow comparison in phenomenology, then phenomenology is agnostic about the relationality of color, and thus the claim that colors appear non-relational cannot be established. Therefore, either phenomenology presents some colors as relational or it says nothing at all about relationality. In either case, McGinn's argument cannot be established.

3.2.2. Usefulness

I agree with Cohen that there is no viable alternative to relativism about color judgments. The problems of specifying a standard observer and duly acknowledging intersubjective and interspecies variation seem intractable for the physicalist. However, I find Cohen's brand of relativism unsatisfying. That every red is *red for S in C* seems unobjectionable, but hardly informative. Each perceiver's red may be really red in a relative sense; however, certain reds are more useful to certain perceivers than others.

I agree with Cohen that it would be arbitrary to say, for instance, that chromatic perceivers see the world as it really is while achromatic perceivers do not. My criticism, however, is that it would be wrong to say that the achromatic perceiver sees the world *just as well* as the chromatic perceiver. This option is not available to Cohen because of how he conceives of functions. He explicitly rejects the teleological/adaptive reading that "something is functional for an organism by virtue of bringing about an increase in the

adaptive fitness of its species," in favor of the non-teleological proposition that "something is functional by consisting in the accomplishment of a certain task, abstracting from issues about its implementation" (Cohen 2009, 179). Because role functionalism is "entirely independent and agnostic about teleology and adaptivity" (Cohen 2009, 179), the biological functions of color vision are left unconsidered. Cohen is limited to the claim that whatever is *red for S in C* is truly red for that perceiver. However, he cannot account for the fact that certain organisms have better or worse color vision relative to the perceptual tasks they use color vision to accomplish, since he abstains from making any claims as to "whether colors are connected with any adaptive function" (Cohen 2009, 179).

Consider the following example. Suppose we have two monkeys: one who has normal trichromatic vision and one who has, for some reason, temporarily lost the ability to perceive color and sees the world only achromatically. It is widely held among evolutionary theorists that color vision assisted primates in the task of object-discrimination, specifically discriminating brightly colored fruit from foliage (Mollon 1989; Jacobs 1993). As Mollon writes: "To find orange and yellow fruits amongst foliage, the monkey needs trichromatic colour vision; without it, the monkey would be at the very disadvantage emphasized in the early accounts of human colour blindness" (Mollon 1989, 33). Now, the achromatic monkey sees correctly according to its visual system and the chromatic monkey sees correctly according to its visual system; however, I think it would be a mistake to say that both monkeys perceive color equally well. The achromatic monkey does not see as well as the chromatic monkey because it will not be able to perform its usual visually guided tasks with the same degree of effectiveness.

I think Cohen is right to relativize color judgments, but wrong to leave his relativism un-supplemented by considerations of the uses of color vision. Usefulness appears to me as the most promising candidate for such a supplement. Matthen (2005) and Chirimuuta (2015) conceive of perceptual correctness and error along these lines, and, as I will argue in the following chapters, I think their accounts are superior to Cohen's role functionalism in this regard.

4. Sensory Classificationism

Sensory classificationism is a relational realist theory based in two main theses: the Sensory Classification Thesis and the Sensory Signalling Thesis. The Sensory Classification Thesis is the claim that "sensory systems classify and categorize; they sort and assign distal stimuli (i.e. external sensed objects) to classes" (Matthen 2005, 13). In color vision, an organism sorts wavelengths of light (distal stimuli) into color-classes according to that organism's classificatory scheme. For example, according to the human color scheme, ripe bananas, caution signs, and egg-yokes are sorted into the yellow class, while raspberries, mailboxes, and blood are sorted into the red class. The Sensory Signalling Thesis is the claim that "sensory experience is a *signal* issued in accordance with an internal convention" (Matthen 2005, 23). A ripe banana *looks* yellow because the sensory system has assigned it to that color-class, and it signals this classification by tagging it with a 'yellow look.' Taken together, these two theses lead to a reversal of the popular view that for something to *be colored* it must *look colored*; rather, the sensory classificationist argues, "a sensory system makes a thing look blue only after it has determined that it *is* blue" (Matthen 2008, 393).

Since *being colored* is prior to *looking colored*, colors are identified with the distal stimuli that the sensory system sorts and signals in color experience. In other words, colors, as classes of distal stimuli, act as *inputs* to the sensory system, while color experiences are the *outputs* of the sensory system. This distinction allows Matthen to simultaneously maintain the realism of physicalism while responding to the eliminativist's objections concerning phenomenology and perceptual variation. The distal stimuli that sensory systems classify are real and perceiver-independent, but the

properties perceivers represent and the ways perceivers represent these properties may differ according to the perceiver's classificatory scheme.[4]

4.1. Motivations

Sensory classificationism is "motivated by considerations about how animals, including humans, use perception" (Matthen 2005, 1). This stands in stark contrast to eliminativist theories of color which assume that "sensation does not directly tell us anything about the external world" (Matthen 2005, 2). Instead, Matthen argues that the fact that our sensory awareness allows us to navigate and reason successfully about our environment suggests that this information must be "anchored in *real* observer-independent features located in three-dimensional space" (Matthen 2005, 5).

Unlike Cohen, Matthen's account is concerned with the *usefulness* and *biological function* of color vision: how sensory systems classify external stimuli, what these

[4] Thompson et al. (1998) classify an early version of Matthen's position as a species of physicalism. This might make sense for the Matthen of 1988, but not of 2005. In *Seeing, Doing, and Knowing*, Matthen acknowledges the narrowness of his earlier account, remarking that the identification of color with reflectance is an inaccurate conclusion to draw from color constancy: "Bradley and Tye (2001), and Byrne and Hilbert (2003), take colour constancy to indicate that colour vision detects an illumination-independent property of objects. This is something of a stretch, given how much our colour experiences of objects actually varies with circumstance. (I was guilty of the same stretch in Matthen 1988)" (Matthen 2005, 158). Matthen's pluralist proposal is not intended to be relativistic in the same sense as Cohen (2009). He writes: "The suggestion is not that the colour properties need to be relativized to observers. […] It is rather that different species might be converging on different properties of distal stimuli" (Matthen 2005, 202). So, although he does identify color with objective properties (distal stimuli), I believe that the fact that the properties represented may differ between species sufficiently distances Matthen's account from standard realism and puts it closer to relational realism. Cohen (2009) shares this view, arguing that sensory classification is a form of relationism because it "construes colors in terms of relations between distal objects and subjects; in particular, the relations in question relate objects to the sensory classifications made by subjects' visual systems" (Cohen 2009, 229).

external stimuli are, and how organisms use this information. There are three distinct advantages to Matthen's approach: (i) it offers a realist response to interspecies variation, (ii) it explains phenomenal color structure without accepting eliminativism, and (iii) it uses biological function rather than veridicality to account for perceptual error.

4.1.1. Perceptual variation

Matthen argues that anthropocentric physicalists "cannot account for colour vision as it occurs in other species" (Matthen 2005, 164), and "cannot accommodate the diversity of properties detected by colour-vision systems" (Matthen 2005, 176). It is arbitrary to choose human color vision and the objective properties it picks out as definitive of color. For example, a pigeon's ultraviolet vision does not detect surface properties; rather, it detects the pigeon's orientation toward the sun (as the sun emits a high concentration of ultraviolet rays) (Matthen 2005, 173). Since direction is not a surface property, the physicalist must accept the awkward conclusion that the pigeon's ultraviolet colors are not really colors.

Matthen argues that "it is far from clear why the realist must insist on there being a *single* mind-independent property that is colour" (Matthen 2005, 175). Instead, he proposes a pluralistic realism that gives "any feature that needs to be processed by wavelength-differentiating light sensors" an equal claim to reality (Matthen 2005, 188). Whether reflectance (in the human case) or direction (in the pigeon case), any distal stimulus which is processed by a color visual system (i.e., wavelength-sensitive receptors) has the right to be called "color."

4.1.2. Phenomenology

There is no physical property isomorphic to the color space. Ordered triples of reflectances cannot explain unique and binary hues, nor the resemblances between them. Unlike physicalism, Matthen has a clear response to this problem. From the sensory classificationist perspective, there is "nothing anomalous or even surprising about this" because the relations of phenomenal color are simply "products of the system's classificatory activity" (Matthen 2005, 191). For example, *purple* is nearer to *green* than *red* in the color spectrum, but more similar to *red* than *green* in color experience. The fact that the relations of the human color space are not represented in the light spectrum should not push us towards denying the reality of color, as the eliminativist supposes, but, rather, to acknowledge that there are more useful ways for humans to order and represent wavelength stimuli than strictly according to the light spectrum. As Matthen argues, the human color system is "classifying stimuli for its own purposes," and the "wavelength-based ordering may not, or may not uniquely, suit these purposes" (Matthen 2005, 191). Instead of taking the spectrum as our sole guide to objectivity, Matthen argues that the structure of phenomenal color "must be assessed from the point of view of function and utility" (Matthen 2005, 192).

4.1.3. Usefulness

One of the main differences between Cohen's role functionalism and Matthen's sensory classificationism is in their use of the term 'function.' Cohen explicitly states that his account is adaptively agnostic: it does not make any claims about the biological function of color vision (Cohen 2009, 179). Sensory classificationism, on the other hand, is evidently motivated by how organisms use perception. Matthen offers the following list of epistemic practices color vision allows humans to perform:

> to co-classify things for purposes of induction, for example, to make generalizations concerning the ripeness of fruit, or the health of one's conspecifics;
> to re-identify things on different occasions, for example, one's car in a crowded parking lot;
> to segment the visual scene into figure and ground, adjacent things of similar colour being both assigned to the figure or both to the ground;
> to find things by visual search, for instance red or orange fruit against a background of green foliage; and
> to match and differentiate things by the colour-looks they present, in order to be able tell, for instance, which part of a uniformly coloured lawn is shaded by trees. (Matthen 2005, 230)

Acknowledging adaptive functions, Matthen can speak of color vision's usefulness, whereas Cohen cannot. For Matthen, the function of perception is to enable an organism to interact effectively with external objects, guiding its actions and helping it to learn about objects, to build records of their features, and to form expectations about future interactions (Matthen 2005, 8). Generally speaking, perception errs when the organism's classification of distal stimuli obstructs its environmental interactions. A sensory classification is *wrong* if it "disrupts a specialized function that this classification is supposed to aid" (Matthen 2005, 206). More specifically, an organism's color vision is in error if it classifies wavelengths in a way that interferes with the specialized functions of color vision.

According to Matthen, there are two broad categories of perceptual error: (i) individual error, and (ii) species error. Individual error occurs when one's sensory system classifies stimuli in a way that inhibits one's reasoning about the external world. "We say that she has committed a perceptual error because her inferential activities were disrupted by her classifying the fruit as green in violation of her normal practice" (Matthen 2005, 208). For example, if I classify an unripe banana as yellow, and in my normal practice I take a banana's yellowness to mean that the banana is ripe, then this would be an instance

of perceptual error. Species error occurs when the species "possesses a wrong classification scheme (or more accurately, a wrong similarity ordering); the scheme does not serve its function adequately" (Matthen 2005, 208). For example, if I were to classify distal stimuli the way a dog does, my sensory system would be guilty of species error (Matthen 2005, 207). The assumption here is that a species' color classification scheme has evolved to suit the kinds of environmental interactions that that particular species uses color vision to perform.

The appeal to usefulness also allows Matthen to account for cases of normal misperception (e.g., reflectance-recovery errors). For example, human color constancy is imperfect in that it does not always accurately recover the reflectances of objects (e.g., in cases of metamerism or surround-contrast illusions). However, it is far more useful in the context of the ways humans use color vision to have imperfect rather than perfect reflectance-recovery abilities. The imperfection of color constancy enhances perceptual similarities relevant to our uses of color vision (Matthen 2005, 44). As Matthen remarks in an earlier article, "it is better to use an imperfect indicator than to have no access to task-relevant properties. To use veridicality as a filter on this range of situations is to show a touching, but quite unbiological, devotion to truth" (Matthen 1988, 13).

4.2. Criticisms

4.2.1. Function specificity

In specifying functions for sensory systems, Matthen's sensory classificationism certainly says more than Cohen's role functionalism, but does it say too much? Cohen (2009) and Chirimuuta (2015) believe it does. Cohen remarks that he is "dubious that color properties are as directly connected with such functions as Matthen supposes"

(Cohen 2009, 229). Similarly, Chirimuuta acknowledges the importance of Matthen's discussion of the connection between perception and biology, but argues that "he goes as far to say that each system has evolved to serve a particular function" (Chirimuuta 2015, 108). She remarks that it is not hard to find counterexamples to Matthen's claim, "such as creatures that spend their lives buried in mud but have perfectly good color visual systems" (Chirimuuta 2015, 109; cf. Chittka and Briscoe 2001). Chirimuuta instead opts for the weaker claim that "perceptual systems serve a function," that is, some function or other, and "that this implies that the 'descriptions' they yield are interest-relative" (Chirimuuta 2015, 109).

I think Cohen (2009) and Chirimuuta (2015) are right to be suspicious of the specificity with which Matthen attributes functions to sensory systems. I don't deny that sensory systems serve functions yielding interest-relative representations, but whether these are the same functions that Matthen posits is another matter. The designation of specific functions to specific sensory systems seems sensible if we only consider cases of normal human perception, but it is difficult to see how this model would accommodate abnormal cases, such as color synesthesia. For example, how, on Matthen's account, would we explain the functions of a sound-color synesthete's auditory and visual systems? Do we consider them as two distinct systems with distinct functions? Or as one system possessing the summed functions of both individual systems? Or as a third system with its own unique functions? The answers are not clear on Matthen's account. Matthen does allow that "some members of species might construct idiosyncratic sensory classification schemes based on sensory capacities that outstrip other members of the same species in representational significance" (Matthen 2005, 207-208); however, the

only example he discusses is 'perfect pitch,' an idiosyncrasy involving only one sensory modality.

4.2.2. Sensory classes

Issues of function specificity also raise problems for Matthen's account of perceptual error. According to sensory classificationism, an organism perceives incorrectly if it classifies stimuli in a way that disrupts its inferential activity about external objects. In other words, incorrect classification obstructs environmental interaction, whereas correct classification enhances it. If we consider only normal cases of color perception, this claim might seem innocuous, but difficulties arise once we consider color synesthesia.

For example, in sound-color synesthesia, distal stimuli (sonic vibrations) are co-classified by two sensory systems (aural and visual). On Matthen's account, it's not clear whether a synesthete's visual co-classification of a sound stimulus would be an act of correct or incorrect perception. On the one hand, if we follow his "Functional Definition of Colour," which states that "a colour classification is one that is generated from the processing of differences of wavelength reaching the eye, and available to normal colour perceivers only by such processing" (Matthen 2005, 167), then the synesthete's classification of sound is not only wrong, but synesthetic color is *not* color. On the other hand, since Matthen's criterion for perceptual error is whether or not the classification disrupts inferential activity, it would seem that the correctness of a synesthete's co-classification of sonic stimuli as sound and color might depend on how it affects the synesthete's reasoning abilities. If enhances it this ability, the synesthete perceives correctly; if not, the synesthete perceives incorrectly. Certainly this kind of perception is

abnormal, but there's little evidence to suggest that it inhibits the subject's environmental interactions. Rather, the consensus among synesthesia researchers is that synesthesia is more likely to assist in basic perceptual tasks, such as object discrimination (Blake et al. 2005), and more complex cognitive tasks, such as metaphor-making and artistic creation (Ramachandran & Hubbard 2001).

So, I share Cohen and Chirimuuta's worry that Matthen's ascription of specific functions as *proper* to certain sensory systems goes too far for a general theory of perception. Such hypothetical functions are valuable in the ongoing project of understanding perception, but I believe taking them as our standards for perceptual error is premature. Rather, I think we are much better equipped to handle cases of synesthetic perception if we think of perceptual functions as being *commonly associated* but not *proper* to any one sensory modality. Typically, wavelength stimulus and visual processing result in 'colour-looks,' but not always (as in the case of sound-color synesthesia). These exceptions, however rare, should not be excluded from color or treated as misclassifications if they aid the organism's environmental interactions.

PART II. PERCEPTUAL PRAGMATISM

In Part I, I discussed four theories of color—physicalism, eliminativism, role functionalism, and sensory classificationism—in relation of six issues in color ontology: phenomenology, perceptual variation, common sense, disagreement, illusion, and the usefulness of color vision. Physicalism—the view that colors are physical properties of objects—maintains the common sense belief that objects are colored and provides an objective standard for settling perceptual disagreements, but it has difficulty accounting for the structure of phenomenal color (i.e., the unique-binary distinction and resemblance relations) and perceptual variation across perceivers and species. Eliminativism—the view that there are no colors—defies common sense and reduces all color judgments to falsity, but it avoids the problems of color structure and perceptual variation. Role functionalism—the view that colors are functional role properties that dispose objects to appear colored to certain perceivers under certain circumstances—seems to advance on all these issues, but its relativistic response to perceptual variation and disagreement lacks considerations of usefulness. Sensory classificationism—the view that colors are classes of distal stimuli relativized to the classificatory scheme of perceivers' sensory systems—seems able to offer a response to all six of the issues discussed, but its account of function specificity and perceptual error make it difficult to account for synesthetic colors.

In Part II, I introduce Mazviita Chirimuuta's perceptual pragmatism. Perceptual pragmatism consists of two main theses: (i) that colors are properties of interactions between a color perceiver and an external stimulus that induces color experience, and (ii) that perceptual states are correct insofar as they are useful to the perceiving organism. In regard to the four theories introduced in Part I, the latter thesis is shared by sensory

classificationism, but no other theory shares the view that colors are properties of interactions. In chapter 5, I introduce the first thesis—that color are properties of interactions—and defend it against some initial criticisms from Cohen (2015) concerning perceiver-dependence, predication, and phenomenology. In chapter 6, I introduce the second thesis and show how a theory based on usefulness is better equipped to respond to concerns of perceptual variation, disagreement, and illusion than theories based on correspondence. In chapter 7, I argue that the joint acceptance of these two theses gives perceptual pragmatism the distinct ability to (i) recognize the reality of synesthetic colors, (ii) distinguish synesthetic colors from normal colors, and (iii) mitigate the ontological excess of ascribing synesthetic color properties to objects. I also show how considerations of synesthesia provide further responses to Cohen's initial criticisms of Chirimuuta's adverbialism. In chapter 8, I consider the common sense objection that colors don't look like properties of events. I acknowledge that perceptual pragmatism does conflict with the common sense view that colors look like properties of objects, but I argue that there are examples in ordinary phenomenology in which color seems to appear as a property of an event rather than an individual (e.g., chromatic adaptation or after-imaging), and that we can remove some of the difficulties in accounting for such phenomena if we adopt perceptual pragmatism.

5. Perceptual Pragmatism

In *Outside Color* (2015), Mazviita Chirimuuta introduces a new theory of color, perceptual pragmatism, based on two main theses: (i) that colors are properties of interactions between certain kinds of perceivers and stimuli, and (ii) that perceptual states are correct insofar as they are useful to perceivers. In this chapter, I introduce the first thesis and respond to some initial criticisms from Cohen (2015) concerning perceiver-dependence, predication, and ordinary phenomenology.

5.1. Adverbialism

Instead of conceiving of color as a property of objects, Chirimuuta proposes an adverbialist account in which colors are properties of interactions between perceivers and stimuli (Chirimuuta 2015, 17). Against the orthodox view, she argues that **"**there is no color-in-the-object, on the one hand, and color-in-the-mind, on the other; there is just one color—the property of a perceptual process" (Chirimuuta 2015, 154). By "process," she means *event*, and by "property," she means *adverb*. Both of these concepts deserve some introduction and clarification.

An event is a unit of space-time, that is, a spatial location and temporal duration. An adverb is an adjective of an event. For example, a clapping of hands is an event: it takes up space and it happens over time. A description of how the hands clap is adverbial. Perhaps the hands clap *quickly* or *hard* or *rhythmically*. Each of these terms describe the event, but they are not objects in the event. I can't locate "rhythmically"; I can't point to some part of the clapping hands and say *that there* is "rhythmically" (or at least not without some explanation and reference to time).

Perhaps the name most closely associated with adverbialism in 20th century analytic philosophy is Wilfrid Sellars. Sellars (1975) proposes that the correct analysis of a statement like "I have a sensation of red" is "I sense red-ly." In his view, red is not a property of an object, but a way in which the perceiver senses; it is an activity, a perceptual process. Chirimuuta's adverbialism follows Sellars for the most part, but with one important exception. Where Sellars locates the relevant event in the perceiver—as a *way of sensing*—Chirimuuta argues that "the relevant events—perceptual interactions—involve both perceiver and the extra-dermal environment" (Chirimuuta 2015, 144). I favour Chirimuuta's version of adverbialism because it allows us to include objective properties (e.g., reflectances or sonic vibrations) in our descriptions of color-seeing events. The inclusion of objective properties is important because it enables us to distinguish normal colors from synesthetic colors by referencing the kind of stimulus involved in the perceptual interaction. I revisit this issue in chapter 7.

Chirimuuta's complete adverbial definition of color is as follows:

> **Colors** are properties of perceptual interactions involving a perceiver (*P*) endowed with a spectrally discriminating visual system (*V*) and a stimulus (*S*) with spectral contrast of the sort that can be exploited by V. (Chirimuuta 2015, 140)

By "perceiver," she means "any sighted animal with the right kind of visual system" (Chirimuuta 2015, 140). By "visual system," she means "the visual machinery of all creature conventionally classified as having color vision proper, but not those with just the capacity to perform reflexive behaviors in response to stimulation with specific wavelengths of light" (Chirimuuta 2015, 140). For instance, a worm that responds to wavelength-stimulus does not qualify as having color vision. The organism's visual system must involve opponent-processing (i.e., signal processing involving unique hues

and their combinations) and some degree of color constancy. By spectral contrast stimulus, she means an excitation that "reflect[s] or generate[s] patterns of light with wavelengths in the discriminable range of at least one kind of visual system" (Chirimuuta 2015, 141). Under this definition, relevant stimuli include objective properties, such as reflectances, and events, such as the play of rainbow colors when a black-and-white-patterned disk is spun.

5.2. Objections and replies

The chapters that follow are devoted to the motivations and criticisms of perceptual pragmatism in regard to the six main issues discussed in Part I: phenomenology, perceptual variation, common sense, disagreement, illusion, and the usefulness of color vision. For now, let me address a few initial objections to Chirimuuta's adverbialist proposal. In his review of her book, Cohen (2015) criticizes her adverbialism for making colors perceiver-dependent, and for conflicting with ordinary language and phenomenology. In response to the first criticism, I argue that perceiver-dependence is a virtue rather than a vice of Chirimuuta's theory, which advances on issues of causal efficacy and ontological excess that plague perceiver-independent relationist views like Cohen's own role functionalism and Matthen's sensory classificationism. In response to the second criticism, I acknowledge that adverbialism conflicts with our common sense conception of color, but I argue that the common sense conception of color also obscures some essential features of color, such as temporality. In chapter 7, I return to this line of response, showing how commitment to the common

sense conception of color leads us to wrongfully deny synesthetic colors the same ontological status as normal colors.

5.2.1. Perceiver-dependence

Since colors are properties of interactions between perceivers and the environment, colors are necessarily perceiver-dependent. Colors are present only where perceivers are present; and so in the absence of perceivers, nothing is colored (Chirimuuta 2015, 149). Cohen (2015) raises the familiar objection to perceiver-dependent ontologies that it is "counterintuitive" and "idealistic" to suppose that "colors go in and out of existence with these events—say, when perceivers die, close their eyes, or shift their attention" (Cohen 2015). The rapid termination and creation of color strikes me as inoffensive, however. Chirimuuta is not arguing that physical properties like reflectance go in and out of existence. She does not deny that objects are disposed to appear colored to certain perceivers, nor that this dispositional property is perceiver-independent. Rather, perceptual pragmatism denies that we should identify color with this disposition in the first place. Reflectances exist, perceivers exist, illuminants exist, and when they interact, color, as a property of this interaction, exists as well.

By making colors perceiver-dependent, perceptual pragmatism has a few distinct advantages over role functionalism. First, one of the challenges for Cohen's account is to show how colors, being functional roles, are causal efficacious. It seems that it is the realizer of the functional role, not the role itself, that disposes an object to appear colored to certain perceivers under certain circumstances. If realizers, not roles, are what dispose objects to appeared colored, then it seems redundant to claim that both realizers and roles are causally efficacious. In response, Cohen claims that functional roles are causally

efficacious in the minimal sense of being necessary causes of color, and that realizers constitute, rather than compete with, functional roles for causal efficacy.[5] The perceptual pragmatist can avoid the role functionalist's causal worries while maintaining the reality of color by accepting perceiver-dependence. Chirimuuta argues, citing Brogaard (2012), that perceiver-dependence explains why colors have no place in physical theories. Since colors depend on perceivers, it is impossible for them to be part of a mind-independent objective world.

Perceiver-dependence also avoids the ontological excess of other relational accounts. For example, on Cohen's account, red is the functional role of *red for S in C*, where *S* is a color-perceiving subject and *C* is a viewing circumstance. Given the number of color perceivers and possible viewing circumstances, each object bears a considerable amount of properties in Cohen's ontology. Similarly, Matthen's sensory classificationism pluralizes color so that any represented feature of distal stimuli which is sensed by wavelength-receptors is an instant of real color. The perceiver-dependence of Chirimuuta's adverbialism restricts color only to events where the relevant conditions

[5] Cohen adapts a proposal from Yablo (1992) to argue that the causal efficacy of colors (as functional roles) is not *competitive with* but *constituted by* their realizers. In his view, realizers and roles operate on two different, non-competitive levels of causation: the former non-necessary and specific, the latter necessary and general. Color realizers are seen as *partially determining* the color roles, meaning that they causally explain color experience "relative to truths about materials, visual systems, and laws" (Cohen 2009, 211). Color roles, on the other hand, are necessary causes of color, whose nature is irrelevant to scientific endeavours to determine the sufficient causes (realizers) of color. As Cohen remarks, "allowing necessary causes that are role properties positively *invites* us to pursue the empirical project of looking for other (non-necessary) causes: for citing a role property as a cause leads naturally to the question of what, as a matter of contingent fact, realizes the relevant role" (Cohen 2009, 215). Since these two properties are not causally competitive, "which of them is cited in a causal explanation is a matter of choice of how general or specific … we want to be given the communicative and explanatory needs at hand" (Cohen 2009, 210).

obtain (that is, *P*, *S*, and *V*). Objective properties need not account for the innumerable ways an object can appear colored to different perceivers under different viewing circumstances. There is color only where there is the right kind of interaction; otherwise, there are only the properties found in physical theories.

5.2.2. Event properties

Cohen criticizes Chirimuuta's adverbialism for conflicting with the orthodox view that colors qualify individuals rather than events, a tradition which is "endorsed by more or less every other color ontology, supported by the grammatical structure of color predications in every natural language of which I'm aware, and arguably also by ordinary color phenomenology" (Cohen 2015).

First, there is no denying that the view that colors qualify events rather than individuals is an unpopular position. However, there are some distinct advantages to adopting an ontology where colors are properties of events. One such advantage is the ability to recognize the temporal aspects of color perception. Sensory systems have temporal limitations for color perception. For humans, the shortest duration for perceiving chromatic stimuli is between 2-4ms (Pokorny et al. 1979, 103). For most human perceivers, events that last less than 2ms do not appear colored. Therefore, a perceptual interaction involving a human perceiver and a spectral contrast stimulus must be at least 2ms for color to be instantiated.

I think we would be wrong to say that color is instantiated by an event whose duration is less than 2ms and involves a human perceiver and light stimulus. Such a restriction could be built into a definition of color on an account in which color is defined as a property of an event, but if one holds the view that colors are properties of objects, it

is not clear how one would account for this fact. Since Cohen and Matthen argue that color is a property of objects rather than events, I assume they would want to deny my claim and affirm that colors exist regardless of the duration of one's perceptual experience. Cohen might want to say that temporal concerns belong to the *C* (circumstances) in *red for S in C*, so that in cases where *S* is human, a necessary component of *C* is that the seeing-event exceed 2ms. However, this is speculative as Cohen gives no explicit treatment of time in *The Red and the Real*. Matthen might want to respond that when we do not classify the too-brief stimulus as color we are misperceiving: our sensory system should sort this distal stimulus into a color class, but its natural limitations prevents it from doing so. However, this response is not clearly consistent with Matthen's usefulness account of perceptual error. In the same way that imperfect color constancy may be more useful to human perceivers in an action-relative sense, I think the same can be said for the temporal limitations of human color vision. A stimulus that lasts less than 2ms is essentially unactionable as far as human perceivers are concerned. The colors of these events would be a noisy distraction compared to the stable colors of ordinary objects, like tables and chairs, whose longer durations allow us to act on them.

Second, the grammatical structure criticism seems to me inappropriate given the atemporal nature of natural language. The issue at hand in color ontology is the nature of color and its place in reality. The implication in this criticism is that since all natural languages treat color predication as the qualifying of individuals, this qualifying of individuals must mirror reality in some relevant way, and in deviating from this structure Chirimuuta's account fails to capture these aspects of color's nature. However, one

important feature of reality which natural language does not represent well is time. Tense is coarse-grained and useful in expressing the order but not the duration of events. Utterances like "The patch is red" equivocate between an atemporal meaning, "The patch has red as an objective property" (e.g., reflectance) and a temporal meaning, "The patch appears red in a seeing-event of such-and-such a duration." Often we predicate colors of individuals in the former sense, as if we could freeze time go on seeing objects as colored. But of course, we know this is not true. Visible light occurs only within the range 430 trillion to 750 trillion Hz—that is, vibrations *per second*. There is no color without temporal duration, and therefore no color without reference to time. To me, Cohen's criticism amounts to the following: "Our tool does not measure time, and so time does not matter." The adverbial approach Chirimuuta proposes can remedy this by putting color *in time*, as a property of events.

Third, I find Cohen's phenomenological objection puzzling. What does he expect a color event to look like? What would satisfy this worry? Colors may appear as properties of individuals, but not outside time. I see individuals as colored within events, as being *in time*, but I don't know what the color of an individual divorced from an event would look like. However, I recognize that many see this common sense objection as a major point against adverbialism, and so chapter 8 is devoted to responding to this issue.

6. Usefulness

Because Chirimuuta conceives of color as *properties of interactions*, her standards for the correctness of perceptual states differ from those who consider colors to be properties of objects. In her view, the correctness of perceptual states is a matter of usefulness rather than correspondence. When asked, "what does it take for a perceptual state to be right?", the perceptual pragmatist responds, "it must work—it must be a *useful* guide to the surrounding environment" (Chirimuuta 2015, 109). When asked, "what are perceptual states for?", she responds, "to help you to live by guiding your activity in the world" (Chirimuuta 2015, 110). In contrast, those who hold a correspondence view of perception would offer something like the following pair of responses: "the external world must correspond to what the perceptual state presents" and "to tell us what is out there in the external world."

I think we have good reasons to reject correspondence in regard to color perception. The correspondence view might conform to how we *think* we use color vision, but recent findings in the perceptual sciences tell a different story. There is no *one* function of color vision (e.g., reflectance-recovery or object-discrimination). Color vision has many functions and frequently these functions come into conflict, compromising the presentation of one property (e.g., reflectance) for another (e.g., objective form). Despite this evidence, the idea that color vision has a single function, and that the failure to perform this function constitutes perceptual error, remains prevalent in the philosophy of color. First, I'll explain the assumptions that underlie the correspondence view of perception. Second, I'll explain, following Chirimuuta, why usefulness is a more appropriate guide to perceptual error.

6.1. Usefulness

According to the correspondence view, a perceptual state is right if the properties it presents correspond to objective properties in the external world. For my perception of a lemon's *yellowness* to be correct, the lemon must bear the objective property corresponding to my perceived yellowness. The assumption here is that there is some objective property that color vision serves to represent, and that the veridicality of color perceptions can be determined by finding out whether or not the object in question bears this relevant property. I call this the *single-function assumption*. It is the assumption that color vision serves a single function, namely, the representation of a certain objective property.

Both realism and eliminativism base their arguments concerning the reality of color on the single-function assumption. For the realist, colors are real because they correspond to objective properties (Byrne & Hilbert 2003a; Matthen 2005; Cohen 2009). For the eliminativist, colors are not real because a corresponding property that accommodates the structure of phenomenal color and perceptual variation cannot be found (Hardin 1988; Maund 1995; Pautz 2006). The underlying claim of the realism/eliminativism debate is that the reality of color depends on its correspondence to an objective property. If there is such a property, color is real; if not, it is not real.

But why must color vision serve to represent only one kind of property? Until fairly recently, the dominant view in the perceptual sciences was that color and form (e.g., object-discrimination or edge-detection) are processed separately. Gegenfurter and Kiper (2003) refer to this as the "coloring book" hypothesis: it is the idea that "the form of an object is processed first, with color being subsequently filled in" (Gegenfurter &

Kiper 2003, 199). The hypothesis implies that the brain uses purely achromatic information to detect the edges and outlines of objects and their movement through space, while chromatic vision adds "something extra," an interest-relative *coloring in* of the scene.

A critical review of the biological and psychophysical literature on color vision indicates that the single-function assumption and the coloring book hypothesis do not reflect our current knowledge of color vision. In a review of the biological literature on color vision, Jacobs (1993) identifies the following adaptive functions of color vision: to detect small objects in a dappled environment (e.g., seeing fruit in trees), to recognize singular objects divided by occlusion (e.g., fruit obstructed by leaves), and to reliably identify objects in different perceptual circumstances (e.g., color constancy) (Jacobs 1993, 456-457). In a more recent review of psychophysical literature on color vision, Shevell and Kingdom (2008) conclude that "chromatic features of a complex scene influence percepts other than color, including orientation, shape, texture, and object segmentation" (Shevell & Kingdom 2008, 159). The sole function of color vision is not, as some suppose, the representation of a single kind of property. In many cases, perfect reflectance-recovery would interfere rather than enhance a perceiver's ability to discriminate and segment objects in a complex scene. The exact list of functions that color vision serves remains contested, but what seems beyond dispute is the claim that color vision serves more than one function. As Chirimuuta argues, "there is no theory-independent reason to assert that [spectral surface reflectance] detection is the primary function and that the others are secondary" (Chirimuuta 2015, 99).

On the perceptual pragmatist view, "the ideal perceptual state is simply one that is useful to the perceiver, not one that can make a claim of correspondence to perceiver-independent states of affairs" (Chirimuuta 2015, 106). By "useful," Chirimuuta means that it enables the organism to interact effectively with its environment. The environment constrains what perceptual states will be informative and what kinds of actions are effective for an organism. In this sense, perceptual pragmatism is a form of realism, but not one that takes reality to be a realm of objective things which veridical perceptual states mirror. Rather, reality is better understood as "that which the mind bumps against" (Chirimuuta 2015, 120)—what tells the organism what *works* and what *doesn't*, what it can and can't do.

6.2. Objections and replies

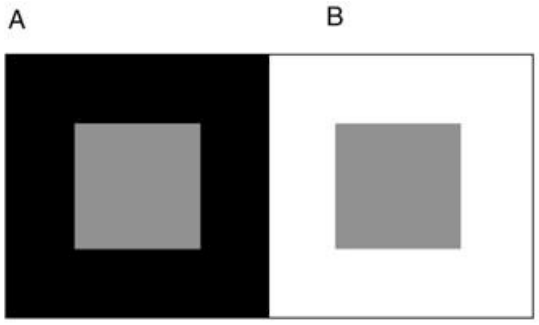
6.2.1. Function-relative veridicality

In his review of *Outside Color*, Cohen (2015) argues that there is no necessary conflict between correspondence and perceptual pragmatism; rather it appears that they "amount to two different, and in principle entirely compatible, yardsticks for assessing perceptual states" (Cohen 2015). The former asks whether the perceptual state corresponds to the external world in some relevant way, the latter, whether the perceptual state is useful to the organism.

I agree with Cohen to a certain extent, but I do not think that correspondence and pragmatism should be placed on equal footing when assessing color perceptions. Correspondence would be applicable if color picked out only one kind of property—if color vision served only a single function—but, as I've shown, this is not the case. If the

statement "This ball is red" were identical to the statement "This ball has such-and-such a reflectance," then its truth *would* depend on whether or not the object in question bears the relevant reflectance property. However, since color does not represent only *one* kind of property and color vision does not serve only *one* function, this analysis seems inappropriate.

In my view, correspondence is only applicable to individual functions of color vision, but not to color vision in general. Let me illustrate this idea by returning to the surround-contrast illusion.



[6]

Look at the image above. For most perceivers, the rectangle in the darker box appears lighter than the rectangle in the lighter box. Now, block out the surrounding boxes of the rectangles: you'll find that the two grey rectangles appear as the same color (and, in fact, they are the same reflectance). In the first case, the task of object-discrimination compromises the task of reflectance-recovery. In order to enhance the perceiver's ability to discriminate objects in the scene, the visual system emphasizes relative differences in color to the detriment of reflectance-recovery. In the second case, where the difference of surround-color is removed and the scene's complexity is reduced, the accuracy of reflectance-recovery increases.

[6] Source: Lehar (2008).

So which case is veridical? If you take reflectance-recovery as the primary function of color vision, then it is the second case. But, as I've established, there is no non-arbitrary reason to prefer reflectance-recovery over color vision's other functions, such as object-discrimination. The first case may not accurately present the reflectances of the rectangles, but by sacrificing precision in this function, the visual system can emphasize the difference between the rectangles and their surrounds, making it easier for the perceiver to discriminate objects in a complex scene. In such instances, when two or more perceptual functions conflict, it should not surprise us that perceived color will be a product of compromise and approximation. Unless we arbitrarily select one function of color vision as the sole criterion for veridicality, correspondence seems to be an inappropriate means of assessing such perceptual states. Rather than call such cases 'misperceptions,' I think the more appropriate standard of assessment is whether the approximate, compromised color in question is useful to the organism's environmental interactions.

By distinguishing the overall functionality of color vision from its individual functions, correspondence and pragmatism can be made compatible in a way that avoids the assumption that color vision serves only one function and represents only one objective property. Veridicality can serve to assess the performance of individual functions of color vision (e.g., reflectance recovery), whereas usefulness can serve to assess the performance of color vision in general.

6.2.2. Disagreement, variation, and illusion

On the perceptual pragmatist view, perceptual states are not assessed in terms of their correspondence to properties in the external world, but by their usefulness to the

perceiving organism. This means that in cases of perceptual disagreement there is no one right answer; rather, correctness is relative to each perceiver's uses of color vision. This position is known as color relativism. The opposing position, color absolutism, argues that there is an objective standard for adjudicating perceptual disagreements, and, therefore, when two perceivers disagree about color, one of them is right and the other wrong.

There are a few advantages to adopting perceptual pragmatism's relativism over the absolutism of physicalism or eliminativism. First, unlike physicalism, color relativism can accommodate intersubjective and interspecies variation. Physicalism identifies colors with physical properties, which means that in cases of perceptual disagreement, there is an objective way of determining who is perceiving correctly. However, it is difficult to establish such a standard once we consider the facts of interspecies and intersubjective variation. Species vary widely in terms of spectral sensitivity and number of unique hues, and normal human subjects often vary when making fine-grain color judgments. As discussed in Part I, there is no non-arbitrary reason to prefer human colors over bee colors or pigeon colors, nor is there a good reason to prefer one normal perceiver's fine-grain color judgments over another's. Color relativism respects the facts of interspecies variation by acknowledging that human colors are right for human activities, pigeon colors are right for pigeon activities, and so on. It also respects the facts of intersubjective variation between normal perceivers by rejecting the implementation of an arbitrary standard for adjudicating perceptual disagreements.

Second, unlike eliminativism, color relativism does not take intersubjective and interspecies variation as support for the view that all color judgments are technically

false. It is possible to misperceive colors, but misperception is not simply a failure to recover a specific physical property; instead, on the pragmatist view, misperception is a failure to represent the external world in a way that enhances the perceiver's environmental interactions. On this view, we can acknowledge that while there is no objective standard to adjudicate all color judgments, there is a distinction between instances of normal colors and illusory colors.

Some issues remain for perceptual pragmatism, however. If the correctness of perceptual states is relative to individual perceivers, then how does the color relativist draw the line between normal color perception and misperception? If *my* colors are right for me and *your* colors are right for you, it seems that, in comparison to absolutism, relativism would make color illusions "very rare" (Byrne & Hilbert 2003b, 58).

I acknowledge that, in comparison to absolutist theories, illusions will be rarer according to perceptual pragmatism. However, I take this as a virtue rather than a vice of the theory. There are many cases of so-called illusions that I do not consider to be genuine cases of misperception, such as the surround-contrast illusion. The surround-contrast example is an illusion only if one assumes color vision has a single function (e.g., reflectance-recovery). But, as I've argued, I think this assumption is mistaken. In place of the single-function assumption, the perceptual pragmatist interprets the correctness of a perceptual state in terms of usefulness rather than correspondence. We perceive correctly when we perceive in a way that enhances our environmental interactions. Thus, the perceptual pragmatist defines misperception as "not seeing as well as we are accustomed to—not seeing well enough to perform our usual visually guided tasks without difficulty" (Chirimuuta 2015, 180). In other words, we perceive color

correctly when our perceptions allow us to perform our visually guided tasks, and we misperceive when our perceptions inhibit our performance of such tasks.

According to Chirimuuta, the only genuine cases of color illusion are what she calls "ecologically relevant misperceptions." These are cases in which a dramatic failure in color constancy inhibits the perceiver's visually guided tasks. For example, suppose you're planning your outfit for the next day, and you decide you'd like to replace the red shirt you've picked out with your only navy shirt. It's late, and so instead of turning on the overhead light, you look through the closet using the dim background light of the bedside lamp. Leafing through hangers, you see some black shirts but none blue. "Is the navy shirt in the wash?" you ask yourself. "Did I misplace it?" You take a handful of dark shirts from of the closet and hold them close to the light. Upon closer inspection, you find the navy shirt was among them the whole time.

In this example, one of the central functions of color vision, object recognition, has underperformed. You are seeing less well than you are accustomed to seeing. As Chirimuuta observes, when we perceive "under conditions that are hostile to our color visual system contributing to all of its usual functions (e.g., at low light levels, or if strong chromatic light leads to failures of color constancy), then we *do* misperceive in a certain sense" (Chirimuuta 2015, 180). Perceptual pragmatism recognizes as misperceptions only those cases where our perception of color does not allow us to perform our usual visually guided tasks.

In contrast, so-called textbook illusions, like the surround-contrast illusion, should not be recognized as genuine cases of misperception. If one assumes that the sole task of color vision is reflectance-recovery, then perhaps such cases would be genuinely illusory.

But, as I've shown, this assumption seems weakly supported. When I see two grey squares as differently colored due to the different colors of their surrounds, I am not misperceiving the colors of the squares; rather, the function of reflectance-recovery is conflicting with the function of edge detection, thus resulting in a compromised presentation. It would be arbitrary to choose one of color vision's functions over another, and thus it would be arbitrary to prefer the color of one square over the other. Given the many functions of human color vision, I take this narrower understanding of misperception as a strength rather than a weakness of perceptual pragmatism.

The same argument also applies to most cases of fine-grain perceptual disagreement. For example, when two normal color perceivers disagree about which color chip is *unique green*, I don't think we can reasonably say that one is right and the other is wrong. Such distinctions are too fine to be adjudicated and too inconsequential to affect most visually guided tasks. However, perceptual pragmatism does not endorse an anything-goes form of relativism in which each perceiver is always right; rather, it is a relativism whose limits are defined by usefulness. If two normal perceivers, Jim and Jane, see the same unripe banana in slightly different shades of green, there are no clear grounds for preferring one's perception over the others. However, if Jim perceiver sees the unripe banana as green while Jane sees it as yellow, leading her to treat the banana as if it were ripe, then we can say that Jane is misperceiving the banana's color, because her perception obstructs rather than enhances her environmental interactions.

7. Synesthesia

Synesthetic color is the color specific to cases of color synesthesia, a neurological condition in which color experience is vividly and reliably induced by stimuli other than visible light. If we base the reality of color on its being located in the external world—as physicalism, eliminativism, role functionalism, and sensory classificationism do—we can approach the ontology of synesthetic color in one of three ways: deny the reality of synesthetic color and affirm the reality of normal color, deny the reality of both synesthetic color and normal color, or affirm the reality of both by ascribing color properties to any stimulus that induces color experience, whether normal or synesthetic.

I find all three options unsatisfactory and propose that if we are to understand synesthetic color we must seek an alternative to the location approach. Chirimuuta's adverbialism is the only theory that avoids the location approach; however, in restricting relevant stimuli to spectral contrast, her definition implicitly excludes synesthetic color. Therefore, I propose the following pair of revised definitions. Normal colors are properties of interactions involving a color perceiver and a spectral contrast stimulus, i.e., a stimulus that reflects or generates light within the range of the perceiver's visual system. Synesthetic colors are properties of interactions involving a synesthete perceiver and a stimulus that reliably induces color experience but does not involve spectral contrast.

Upon making this revision, perceptual pragmatism will allow us to (i) affirm the reality of synesthetic color, (ii) distinguish synesthetic color from normal color, and (iii) avoid excessive ascription of synesthetic color properties to external objects. Theories that follow the location approach to color ontology—physicalism, eliminativism, role

functionalism, and sensory classificationism—can, at best, only accomplish two of these three goals. An adequate theory of synesthetic color must accommodate all three points, and a theory of color is incomplete if it is unable to accommodate synesthetic color.

7.1. Synesthetic color

Synesthesia is a neurological condition in which the stimulation of one sensory modality or cognitive pathway leads involuntarily to experiences in a second modality or cognitive pathway. The original stimulus is the *inducer*, and the experience in the second modality or cognitive pathway is the *concurrent*. Color synesthesia refers to cases of synesthesia in which the concurrent is color. For someone with sound-color synesthesia, hearing a certain sound will lead involuntarily to the experience of a certain color (e.g., sound of a violin → the color red). For someone with grapheme-color synesthesia, the same phenomenon will occur at the sight of certain letters or numbers (e.g., 'R' → the color green). Synesthetic color experience is highly idiosyncratic. Color synesthetes vary widely in terms of inducer-type (e.g., sound-color, grapheme-color, or smell-color) and inducer-concurrent associations (e.g., the sound of a church organ might induce an experience of greenness for one synesthete but redness for another).

Broadly speaking, there are two forms of synesthetic color experience: *projective* and *associative*. Projective synesthetes experience colors as projected into their visual field—a phenomenon that has been substantiated by pop-out, after-image, and Stroop tests (Blake et al. 2005). Associative synesthetes experience synesthetic colors as "being in their mind's eye or head" (Macpherson 2007, 76). To be a genuine case of associative

color synesthesia, synesthetic color experiences must be involuntary, vivid, and reliably associated with certain inducers.

There is some debate as to how we should classify synesthetic colors. Are synesthetic colors most like hallucinatory colors, illusory colors, or normal colors? Each case seems to be an awkward fit. Unlike hallucinatory colors, synesthetic colors involve interactions with external stimuli. Unlike normal colors, these stimuli are not of the kind typically exploited by the human visual system. Unlike illusory colors, they seem to enhance rather than inhibit environmental interactions. Essentially, the problem of synesthetic color consists in a tension between *abnormality* and *usefulness*. They are idiosyncratic and unrelated to the external things normal colors seem to represent, and yet they are prove to be useful in basic perceptual and complex cognitive tasks.

Perhaps the most promising strategy for deflating the problem of synesthetic color is to treat synesthetic colors as illusory. But this remains contentious. Gray (2001) and Alter (2006) argue for this interpretation, while Wager (1999) and Rosenberg (2004) argue against it. I find little evidence in support of the former position. If synesthetic color is illusory, at least one of the following two claims must be true: color synesthesia is maladaptive (i.e., it interferes with the perceiver's environmental interactions), or only normal colors can represent external stimuli. In regard to the first claim, there is no evidence that being synesthetic interferes with one's environmental interactions in a substantial way. Rather, the consensus among synesthesia researchers is that being synesthetic is advantageous for certain perceptual and cognitive tasks. As a group, synesthetes have superior memory, greater than average intelligence, and excel at certain

complex cognitive tasks such as metaphor-making and artistic creation (Baron-Cohen 1996; Ramachandran & Hubbard 2001; Cytowic 2002; Blake et al. 2005).[7]

In regard to the second claim, beyond preserving a prior commitment to externalist representationalism, I find no compelling reason to say that only non-synesthetic experience can relate to representational content**.** Representationalism is, as Alter (2006) defines it, "the view that phenomenal properties are representational properties" (Alter 2006, 2). Color synesthesia poses a threat to externalist representationalism because it allows for the possibility that two mental states, one synesthetic and one not, can be alike in representational content but different in phenomenal character (Wager 1999, 269). Therefore, externalists must claim that synesthetic colors are misrepresentations to ensure that representational content cannot yield different phenomenal properties. In their view, synesthetic colors represent the same things normal colors represent, but since, by definition, synesthetic colors are not caused by the same things as normal colors, synesthetic colors can only misrepresent (Alter 2006, 5).

However, I think this treatment overstates the strength of the relationship between representational content and phenomenal character. For sound-color synesthetes, both the aural and chromatic character of their experience seem to relate to the representation of sound. In fact, for at least some synesthetes, the concurrent experience is not something

[7] O'Callaghan (forthcoming) argues that in regard to the enhanced performance on certain perceptual and cognitive tasks, synesthesia is "accidentally beneficial"—that is, its benefits do not come from strategies that enhance perceptual reliability: "Mnemonic, learning, and aesthetic enhancements, for instance, stem from associations or characteristics internal to experience rather than from improvements to perceptual resolution or accuracy" (7). While this may be true, it does not show that synesthesia interferes with these tasks or environmental interactions in general.

extra, but an inseparable part of experiencing the inducer. One sound-shape synesthete describes his hearing experience as follows: "The shapes are not distinct from hearing them—they are part of what hearing is. … That's what the sound *is*; it couldn't possibly be anything else" (Cytowic 2002, 69). Of course, the aural experience of sound is normal while the chromatic experience of sound is abnormal, but it does not follow that only the former can represent sound.

Considering that in genuine cases of sound-color synesthesia, synesthetic color experience is as involuntary and reliable for synesthetes as aural experience is for non-synesthetes, the choice to reduce synesthetic color to the same status as illusion or hallucination seems weakly supported. If we are to privilege normal phenomenal properties over synesthetic phenomenal properties, I think our reasons must be more than an appeal to the non-synesthete majority. Since I find no such reasons, I opt for the more humble approach of treating normal and synesthetic colors as ontologically similar.

7.2. Locating synesthestic color

In color ontology, there are two main lines of thought: eliminativism and realism. Eliminativism is the view that there are no colors in the external world. Colors cannot be identified with physical properties, and objects are not colored. Therefore, it is, strictly speaking, false to attribute colors to objects (e.g., Hardin 1988; Pautz 2006; Maund 2011). Realism is the view that colors are constituents of the physical world independent of color-perceiving organisms. Since colors are defined as objective properties, the realist's task is to identify color with some such property. Some philosophers choose to specify this physical property, e.g., *reflectance* or *productance* (e.g., Tye 1995; Lewis

1997; Byrne & Hilbert 2003a), while others opt to be agnostic (e.g., Cohen 2009) or pluralistic (e.g., Matthen 2005) on the matter.

According to these views, the reality of color depends on whether color can be located in the external world. If color is a property of objects, it is real; if not, it is not real. This is what Frank Jackson (1998) calls the "location problem" of color—that "colours must, if they are instantiated anywhere, be findable somehow" (Jackson 1998, 87). The location approach to ontology is apparent in both eliminativism and realism. It is present in Barry Maund's eliminativist claim that colors "are virtual in that although I locate them in space they are not there" (Maund 1995, 4), and in Brian McLaughlin's realist claim that "it is a job of vision science to identify the physical property in question and, thereby, to locate the place of redness in nature" (McLaughlin 2003, 486).

This approach may seem unproblematic for normal color, but when applied to synesthetic color some difficulties arise. If synesthestic color is real, it must be a property of objects. However, given the diversity of stimuli that induce synesthetic experience and the idiosyncratic nature of synesthesia, ascription of synesthetic color properties to objects would result in an extreme ontological excess. While the realist might argue that normal color can be restricted to some objective property—say, *reflectance*—there is no such restriction available for synesthetic color. Since synesthetic color is, by definition, color experience caused by something other than what causes normal color experience, all stimuli *except* those that cause normal color experience could be considered potential bearers of synesthetic color properties. In effect, there could be as many such properties in the world as there are inducer-concurrent associations.

If synesthetic color is not real, we have two options: one eliminativist, one realist. The eliminativist option is to claim that synesthetic color, like all color, is not real. On the one hand, this gives synesthetic color the same ontological status as normal color. On the other hand, if all color is not real, it is not clear how we would distinguish synesthetic color from normal color. The realist option is to claim that synesthetic color is not real because, unlike normal color, it is not a property of objects. On the one hand, this distinguishes synesthetic color from normal color. On the other hand, it treats synesthetic color as ontologically different from normal color—a stance, which, as I've argued in the previous section, seems weakly supported.

Although role functionalism and sensory classificationism may not follow the location approach to color as explicitly as physicalism or eliminativism, since both consider colors to be objective properties—the former, as a dispositional property to affect certain perceivers in certain ways, the latter, as a class of distal stimuli—these accounts fall prey to many of the same difficulties described above.

Recall that in Cohen's view, the color red is the property of *looking red* to subject *S* in perceptual circumstance *C*, and *red for S in C* is the functional role that disposes objects bearing it to look red to *S* in *C*. In other words, color is a property that when possessed by an object makes the object appear a certain way to certain perceivers under certain circumstances. There are two strategies for recognizing the reality of synesthetic colors on Cohen's account—either we incorporate synesthetic color within the functional role definition of color (e.g., interpret synesthetic red as a species of the genus *red for S in C*), or define synesthetic color as a functional role distinct from color in general (e.g., *synesthetic red for S in C*).

If we take the former approach, then we reencounter the realist's problem of ontological excess. Since normal color experience is caused by spectral contrast stimuli and synesthetic color is caused by non-visual stimuli, there is no stimulus exempt from bearing color properties. If we take the latter approach, we mitigate the problem of ontological excess, but we exclude synesthetic color from color in general. The claim that synesthetic color is not color seems ad hoc and at odds with the experiential reports of synesthetes. Substantiating this claim requires that we either deny the testimony of thousands of color synesthetes—a gutsy approach for a non-synesthete—or show that synesthetic color is a misrepresentation or illusion. As discussed in the previous section, I find no strong theory-independent reason to privilege normal color over synesthetic color in this way.

According to Matthen's sensory classificationism, colors are identical to the distal stimuli that the organism's sensory system sorts and signals in color experience. In other words, colors, as classes of wavelength stimuli, act as *inputs* to the visual system, while color experiences—or 'color-looks' in Matthen's terminology—act as *outputs*. This distinction allows Matthen to maintain a realism about color while accounting for perceptual variation across species and subjects. The distal stimuli that sensory systems classify are real and perceiver-independent, but the properties perceivers represent and the ways they represent these properties may differ according to an organism's classificatory scheme.

At first glance, sensory classificationism may seem like a promising alternative for accommodating synesthetic color. It seems that one could interpret color synesthesia as a rare kind of classificatory scheme, and synesthetic colors as classes of distal stimuli

that the synesthete idiosyncratically classifies as 'color-looks.' However, if we follow Matthen's functional definition of color, which states that "a colour classification is one that is generated from the processing of differences of wavelength reaching the eye, and available to normal colour perceivers only by such processing" (Matthen 2005, 167), then the synesthete's color classification is not only wrong, but synesthetic color is *not* color (since it is not generated by wavelengths or typical visual processing). Certainly, the stimuli that a synesthete classifies with 'color-looks' are abnormal, but I find no compelling reason to treat such classifications as misperceptions. First, as stated earlier, the consensus among synesthesia researchers is that synesthesia is more likely to aid than inhibit an individual's ability to perform perceptual and cognitive tasks (Cytowic 2002; Baron-Cohen 1996; Ramachandran & Hubbard 2001). Second, the popularity of a certain type of classification is not enough to deny synesthetic colors reality or exclude them from one's definition of color in general.

7.3. Definition revisited

In contrast to the theories discussed, Chirimuuta's adverbialism avoids the location approach to color and thus avoids the above difficulties with regard to synesthetic color. However, although Chirimuuta's general approach to color ontology allows for the possibility of recognizing synesthetic color, her current definition does not. Recall Chirimuuta's definition:

> **Colors** are properties of perceptual interactions involving a perceiver (*P*) endowed with a spectrally discriminating visual system (*V*) and a stimulus (*S*) with spectral contrast of the sort that can be exploited by V. (Chirimuuta 2015, 140)

While I agree with Chirimuuta's adverbial approach, I believe the definition she offers here is of *normal color*, not *color in general*. For example, in cases of sound-color synesthesia, a spectral contrast stimulus is not necessary to induce synesthetic color experience. Unless we want to deny that synesthetic color is color, our definition must not be limited to perceptual interactions involving only spectral contrast stimuli. In order to accommodate synesthetic color, I propose the following pair of definitions:

> **Normal colors** are properties of perceptual interactions involving a perceiver (*P*) endowed with a spectrally discriminating visual system (V_{NORM}) and a stimulus (S_{NORM}) with spectral contrast of the sort that can be exploited by V_{NORM}.
>
> **Synesthetic colors** are properties of perceptual interactions involving a perceiver (*P*) endowed with a synesthetic sensory system (V_{SYN}) and a stimulus (S_{SYN}) that does not involve spectral contrast but that V_{SYN} can exploit to produce experiences that are qualitatively similar to normal color.

In its rejection of the location approach and its inclusion of color experiences not induced by spectral contrast stimuli, I find adverbialism better equipped to deal with synesthetic color. By adopting this pair of definitions we can do three things. First, we can affirm the reality of synesthetic color by putting both normal colors and synesthetic colors on equal ontological footing as properties of interactions and then acknowledging the usefulness of synesthetic colors. Second, we can distinguish synesthetic color from normal color by referencing the character of the perceiver's sensory system and the type of stimulus that induces color perception. Third, we can avoid ontological excess by limiting the ascription of synesthetic properties to certain kinds of interactions rather than extending them to all the diverse stimuli that induce synesthetic color experience.

7.4. Objections revisited

In chapter 5, I addressed initial criticisms to Chirimuuta's adverbialism from Cohen (2015), namely, those pertaining to perceiver-dependence and the predication and phenomenology of event properties. Considerations of synesthesia allow for new responses to these objections, and I argue that those exact features with which Cohen takes issue make perceptual pragmatism distinctly advantageous in accounting for synesthetic colors.

7.4.1. Perceiver-dependence

According to perceptual pragmatism, colors are perceiver-dependent properties. Color is a property of an interaction between a certain kind of perceiver and a certain kind of stimulus; therefore, if either the perceiver or stimulus is absent, there is no color. Cohen objects that this view is "counterintuitive" and "idealistic" because it supposes that "colors go in and out of existence with these events—say, when perceivers die, close their eyes, or shift their attention" (Cohen 2015). However, a theory that claims colors are perceiver-independent implicitly denies the reality of synesthetic colors. Synesthetic colors are ephemeral and highly idiosyncratic. They do go in and out of existence as the synesthete shifts attention, and inducer-color associations vary widely across individual cases of synesthesia. For example, Blake et al. (2005) describe an experiment in which grapheme-color synesthetes were shown two sets of graphemes: '`A 13 C`' and '`12 13 14`.' When perceived in the context of the first set, the synesthetes reported that the middle grapheme induced the color experience associated with 'B.' When perceived in the context of the second set, the synesthetes reported that the grapheme induced the color experience associated with '13.' When both sets appeared together, the synesthetes

claimed they were able "to influence this competition by attending to one context or the other" (Blake et al. 2005, 50).

If synesthetic colors are perceiver-dependent properties, this example poses no threat. The two synesthetic colors associated with '13' go in and out of existence depending on how the synesthete attends to the grapheme. There is no *one* synesthetic color property ascribed to '13' that exists independently of synesthetic perceivers. On the other hand, we encounter some difficulty in explaining this example if synesthetic colors are perceiver-independent properties. In order to maintain the reality of synesthetic color, we would have to either ascribe contradictory synesthetic color properties to the grapheme '13' (i.e., the B-color *and* the 13-color), or claim that '13' actually bears only one of the two synesthetic color properties (e.g., the B-color *or* the 13-color). The first option seems too permissive. It would be contradictory to say that a single object bears different synesthetic color properties simultaneously, and it would be difficult to maintain that a property is truly *perceiver-independent* if its existence depends upon a perceiver's attention. In regard to the second option, it would be arbitrary to choose either the B-color or the 13-color as the one synesthetic color property '13' actually bears.

7.4.2. Predication

Cohen also criticizes Chirimuuta's ontology for conflicting with the usual view that colors qualify individuals rather than events, a tradition which is "supported by the grammatical structure of color predications in every natural language of which I'm aware, and arguably also by ordinary color phenomenology" (Cohen 2015).

To the predication criticism, we have two responses: the first deflationary, the second defensive. The deflationary response is to deny the significance of ordinary

language to issues of color ontology. Chirimuuta is not trying to account for how we talk, nor is she suggesting how we *should* talk. She is clear on this point.[8] If one considers these strikes against her view, then I see no way of overcoming this. What she is suggesting, however, is that color ontology is responsible first to the perceptual sciences and second to common sense and ordinary language. Indeed, it would be remarkable if our ordinary ways of predicating were prescient enough to anticipate the latest scientific developments. Whether reconciling natural language with science should be a task for color ontology is a deeper meta-philosophical issue that I will not address further here; however, I do remain skeptical whether such a reconciliation is possible.

Now for the defensive response. Where adverbialism appears inadequate in accounting for natural language predication, natural language predication seems inadequate for accounting for synesthetic experience. In ordinary language, only certain combinations of sensing verbs and sensory properties make sense. For example, "I hear red" is awkward and nonsensical if one thinks of color as a property proper only to sight. Alternatively, "I see red in my mind's eye when I hear this sound" might be more intelligible, but is more misleading than it is informative. As one sound-color synesthete, RP, reports of his experience, "It's definitely colors, but I'm not sure that 'seeing' is the most accurate description. I am seeing, but not with my eyes, if that makes sense" (Cytowic 1989, 27).

[8] When asked about the awkwardness of the adverbial construction in a recent interview, she responds: "One thing I don't see as part of my project is giving an account of concepts of color that are presupposed in ordinary language. … [B]y proposing this adverbial color ontology, I'm not saying that people should change the way that they talk, but I think that thinking about color in this way makes better sense of how these mind-dependent properties can be integrated into our basic physicalist worldview or naturalistic worldview" (Chirimuuta 2016).

Adverbialism, on the other hand, can accommodate synesthetic statements with considerably less strain. For example, "I hear red-ly" avoids the problem of *locating* synesthetic color, instead interpreting it as a property of an interaction between the synesthete and a sound stimulus. And I think this is more reflective, or at least less misleading, of synesthetic experience. Synesthetic colors are not *things one sees*, but, rather, *ways one* _____ (e.g., hears, smells, or tastes). Provided that we do not immediately reject adverbial statements due to their superficial grammatical strangeness, I think there is an appeal to the adverbial construction. Adverbial analyses of perceptual statements are all more or less unusual, and thus we are less likely to intuitively treat certain sensory properties as proper to only certain sensing verbs. For most non-synesthetes, 'red' only describes seeing-events, but for some sound-color synesthetes, 'red' also describes hearing-events. In either case, 'red' is a property of an interaction involving a color perceiver and a stimulus that induces color experience, not a property that is necessarily linked to any one sensory input.

7.4.3. Phenomenology

Lastly, in response to Cohen's objection that an event view goes against ordinary phenomenology, I'm unclear as to what kinds of examples or reasons could be given to convince him otherwise. It seems to be, quite literally, two ways of looking at the same thing. I perceive colors within the context of perceptual events, but I don't know what the color of an individual divorced from an event would look like. Surface colors may appear as properties of individuals in a certain sense, but not timelessly so. There are also numerous examples in which colors appear as properties of events: the dazzling iridescence of a Benham disk or the swirling rainbows on a bubble's surface or a puddle

of oil. And it seems at least possible, though perhaps implausible, to regard surface colors in the same way. Pasnau (2009), for example, in arguing for an event view of color, claims that he has, "with some practice, … come to see colors as events, as a kind of constant flame (well, roughly) on the surface of objects," and in doing so, "the experience of seeing seems to take on a new and richer character, as if I am only now understanding what I am seeing" (Pasnau 2009, 366).

Chirimuuta argues that phenomenology is agnostic on the matters of whether colors are properties of events or individuals (as I explain in the following chapter). But for those who feel an intuitive resistance to accept this agnosticism, synesthetic color phenomenology offers a counterweight to our intuitions about normal colors. While surface color may appear stable and constant, synesthetic colors induced by sound stimuli tend to involve motion and dynamic form. For one synesthete, SdeM, music is perceived as "colours, moving like dots, like people in a crowd at a football game when the camera zooms in on them" (Cytowic 2002, 194). For another, "sounds are most easily likened to oscilloscope configurations lines moving in color, often metallic with height, width and, most importantly, depth" (Cytowic 1989, 24). And for yet another synesthete, DS, each note of a vibraphone is perceived as a "little gold ball falling" (Cytowic 2002, 69). I see no way of expressing the phenomenology of synesthetic color without reference to events. To say simply that each note of the vibraphone is gold flattens the dynamic character of synesthetic color to the stable color of tables and chairs.

8. Common Sense

Color is a property of an interaction between a chromatic perceiver and a spectral stimulus. In regard to phenomenology, this definition has a few advantages. First, unlike physicalism, it is able to account for the structure of phenomenal color. Since perceptual pragmatism defines color relationally, it avoids the physicalist problem of having to identify a physical property that can explain the features of the human color space, namely, unique and binary hues (e.g., how orange appears as yellowish-reddish) and color similarities (e.g., why purple is more similar to red than green). Instead, these features of phenomenology can be explained as the products of interactions between the organism's perceptual apparatus and spectral stimuli. For example, when a normal human perceiver interacts with a spectral stimulus of a certain kind (e.g., one that stimulates a positive signal in the red-green channel and a negative signal in the yellow-blue channel), the result will be a certain kind of color experience (e.g., purple).

Second, unlike eliminativism, perceptual pragmatism does not claim that colors do not exist. Visual experience presents color as a real part of the external world, and treating colors as if they are real features of the external world usually enhances a perceiver's environmental interactions. Although the structure of phenomenal color cannot be explained without reference to an organism's perceptual system, color experience is grounded in and constrained by the external world. By including external stimuli in its definition of color, perceptual pragmatism can account for these facts without accusing color vision of widespread and systematic error.

Despite these advantages, perceptual pragmatism still faces a common sense objection from ordinary phenomenology, namely, that *colors don't look like adverbs of*

events. Even if we accept that colors can be relational properties (see 3.2.1.), some argue that ordinary phenomenology presents individuals, not events, as the bearers of these properties. In a similar fashion to my defence of Cohen's relationism against common sense objections, I respond that visual experience does not always present colors as properties of individuals.

The common sense objection to Chirimuuta's adverbialism follows the same basic structure as the common sense objection to Cohen's role functionalism except it takes the claim "colors appear as properties of individuals" as its initial premise. We find the adverbial objection in Cohen's review of *Outside Color*, where he remarks that Chirimuuta's view that colors are adverbs of events conflicts with ordinary phenomenology. Colors don't look like properties of events, he argues; rather, they look like properties of individuals. If colors appear as properties of individuals but are in fact properties of events, then "phenomenology is guilty of a widespread and systematic category error in the way it presents colors" (Cohen 2015).

The common sense objection can be standardized as follows:

> I. Colors are presented in our visual experience as properties of individuals.
> II. If colors were properties of events, and color vision were veridical, then colors would not be presented in our visual experience as properties of individuals.
> III. Either colors are properties of individuals, or color vision leads us to systematically misperceive the nature of color.
> IV. We do not have reason to think that color vision systematically misleads us about the nature of color.
> V. *Conclusion*: Colors are not properties of events.

The argument rests on the notion that visual experience presents colors as properties of individuals rather than events. However, I think we have good reason to reject this premise. First, there are instances in ordinary phenomenology where colors are not

clearly presented as properties of individuals (e.g., chromatic adaptation or after-images). Second, maintaining the view that colors are properties of individuals instead of events makes processual phenomena like chromatic adaptation and after-imaging unnecessarily difficult to explain. The purpose of my response is not to argue that phenomenology presents colors as properties of events, but to unsettle the objector's conviction that visual experience presents colors unambiguously as properties of individuals. If this can be done, then we can block Cohen's common sense objection before it begins.

8.1. Chromatic adaptation

Although Cohen does not give a sustained argument for the claim that colors appear in ordinary phenomenology as properties of individuals, the case seems easy enough to understand. In most instances, we seem to see *things*, not events, as colored: tomatoes look red, daffodils look yellow, the sky looks blue, and so on. Even the unsteady colors of CDs and holograms, though arguably relational, appear as properties *of* the objects in question. However, there are instances in ordinary phenomenology in which color does not clearly appear as a property of individuals, namely, in certain cases of chromatic adaptation and after-imaging.

Chromatic adaptation refers to color vision's ability to adjust to changes in illumination to maintain the appearance of object colors. These adjustments occur constantly in visual experience, allowing the visual system "to follow and tune for the ever-varying characteristics of the visual environment" (Webster 2003, 68). When an opponent channel is over-stimulated in such a way that it interferes with basic perceptual tasks (e.g., scene-segmentation), the visual system compensates by adding more of that channel's opponent color to the scene. For instance, when you put on a pair of yellow-

tinted sunglasses outdoors, objects will at first appear unnaturally *yellowish*. As you wear the glasses for a few minutes and the visual system adjusts, object colors will appear more familiar. Later, when you take the sunglasses off, all objects will at first appear unnaturally *bluish* before gradually returning to their normal color.

If one assumes the view that colors appear only as properties of individuals, instances of chromatic adaptation, such as the tinted sunglasses example, seem difficult to explain. How is it that the same stimulus viewed from the same angle with the same light source can appear differently colored at different times? And how does one account for the phenomenon of gradual change of object colors? Whether one holds that colors appear exclusively as non-relational or occasionally as relational properties of individuals, these questions seem to require awkward responses. If one maintains that colors appear only as non-relational properties of individuals, then when all object colors in a scene change simultaneously due to chromatic adaptation, it would appear as though each object in the scene were changing color independently, that is, without relation to other objects in the scene or the perceiver. This seems implausible and discordant with ordinary phenomenology. It does not appear that each object's color is changing independently, but rather that all object colors are changing simultaneously.

If one holds that colors sometimes appear as relational properties of individuals, then the colors of chromatic adaptation must be construed as properties that dispose objects to appear a certain way to certain perceivers under certain conditions. However, the phenomenon of chromatic adaptation is not only a relation between *individuals* (e.g., a certain stimulus, certain perceiver, and certain circumstances), but also between states of the perceiver's opponent-processing. As in the sunglasses example, a certain perceiver,

a certain light source, and a certain object can give rise to different color experiences. Objects do not maintain the same phenomenal color in all perceptual circumstances, and relations between certain objects and perceivers do not guarantee the same phenomenal color. For example, suppose we used Cohen's role functional definition of color to account for the sunglasses example. In Cohen's definition, a certain color (e.g., *blue*) is a functional role property (e.g., *blue for S in C*) that disposes its bearers to appear a certain way (e.g., *bluish*) to a certain subject (*S*) under certain circumstances (*C*). However, it is not clear whether we would appeal to the subject or the circumstance in Cohen's definition to account for the gradual change in phenomenal color during chromatic adaptation. If we appeal to the subject (*S*), then we must say that it is the subject who is changing. Call the subject before wearing sunglasses S_1 and the subject after wearing sunglasses S_2. Suppose that the object in question is a piece of standard printer paper. The printer paper will appear *white* to S_1 in C and *bluish* to S_2 in *C*. However, it seems ad hoc to say that a person is a different perceiving subject before and after wearing tinted sunglasses. If we did make this amendment to Cohen's theory, every perceiver would be as many perceiving subjects as there are opponent-processing states. If we appeal to circumstance (*C*), then we say that it is the circumstance that does the changing. Call the viewing circumstance before wearing the sunglasses C_1 and the viewing circumstance after wearing the sunglasses C_2. Thus, the printer paper appears *white* to *S* in C_1 and *bluish* to *S* in C_2. However, it seems excessive to include a perceiver's state of opponent-processing under the circumstance component. There is no feature external to the perceiver that has changed in C_1 and C_2, and to say that different states of a perceiver's

opponent-processing are distinct circumstances seems to overburden Cohen's concept of circumstance, which already includes illumination and viewing angle.

Chirimuuta's adverbialism—which interprets colors as *ways of seeing* objects rather than properties *of* objects—seems to offer the most natural interpretation of chromatic adaptation. According to Chirimuuta, when ones see a red ball, the *redness* experienced is "a mode of presentation of [the ball's] spectral and nonspectral properties" (Chirimuuta 2015, 169). Redness is a way of presenting the ball's reflectance, shape, and material stability (among other properties) to the perceiver. The perceiver is not seeing any one property corresponding to redness; rather, redness is a way of seeing the object's properties. In other words, the perceiver is not seeing some property *redness*, but instead the perceiver is seeing the object's properties red-ly.

To return to the sunglasses example, when I take off my yellow-tinted lenses, I am not seeing blueness as a property shared by all objects in the scene; rather, I am seeing blue-ly. I do not see any particular object as blue, but I see all objects temporarily in a bluish way. *Blueness* is a way of seeing the scene's objective properties, effective when wearing the yellow-tinted sunglasses, but ineffective upon the sunglasses' removal.

In responding to the common sense objection to Cohen's role functionalism (3.2.1), I showed how altering relations can reveal that a seemingly non-relational phenomenal property is relational. By adjusting one's viewing angle and the light source, the colors on the back of a CD shimmer and change. Similarly, I respond to the adverbial objection by claiming that altering one's perceptual processing can reveal a seemingly static or non-temporal property as processual. By wearing yellow-tinted sunglasses for a few minutes to alter one's state of opponent-processing, then comparing how objects

appear before and after the alteration, visual experience reveals color as being the property of a process rather than an individual. This example shows that phenomenal colors are not only affected by the perceiver's viewing angle and light source, but also by the perceiver's state of opponent-processing. Phenomenal colors are not static, nor do they depend solely on relations between external objects; rather, they are properties of interactions between perceivers and external stimuli.

Two objections remain for the adverbial interpretation of chromatic adaptation. First, one might argue that altering one's perceptual processing and comparing how object colors appear before and after adds an inferential element unbefitting raw phenomenology. I do not dispute this; however, as with the common sense objection to Cohen's role functionalism, it is irrelevant to my argument whether the processual nature of color is apparent in phenomenology or requires an extra inferential step. In either case, the original premise of the adverbial objection—that colors appear as properties of individuals—cannot be established. If one allows this kind of comparison in phenomenology, then some colors appear as properties of events in visual experience (e.g., chromatic adaptation colors), and therefore the claim that all colors appear as properties of individuals in visual experience cannot be established. If, on the other hand, one does not allow comparison in phenomenology, then phenomenology is agnostic about the processual nature of color, and thus the claim that colors appear as properties of individuals cannot be established.

Second, one might argue that although all object colors undergo an apparent change in certain instances of chromatic adaptation, it is still objects, not events, that appear to undergo a change in color. However, if chromatic adaptation does not count as

instance in which color appears as the property of an event, it is not clear what would. In the sunglasses example, upon taking off the glasses, one experiences the process of *bluish-seeing* giving way to *normal-seeing*, a process which does not appear as attributable to any objective property in the scene, nor any simple relation between perceiver and external world. Rather, the phenomenal *blueness* in this example appears as ephemeral and global. If one cannot accept this as a genuine instance of color appearing as a property of an event rather than an individual, then I must resign myself to disagreement.

8.2. After-images

The view that colors are *ways of seeing* objects rather than properties of objects also helps us to deal with the problem of after-images. An after-image is an especially vivid and immediate case of chromatic adaptation.[9] When exposed to an intense stimulus, the visual system compensates by producing a transient blotch of the stimulus's opponent color in the relevant portion of the perceiver's visual field. For example, if you stare at a red light for a few moments, then look away at a white wall, you will notice a green blotch resembling the light's shape and in the light's earlier position in the visual field.

For those who believe that colors qualify individuals, after-images are a source of persistent philosophical difficulty. They are part of visual experience, but not part of the external world. They take up space in our visual field, but they cannot be acted upon. They do not represent external objects, yet they are induced by external stimuli. If color

[9] In the context of this argument, I take 'chromatic adaptation' to refer to instances of successive contrast that are more gradual and global (i.e., involving the entire visual field), and 'after-imaging' to refer only to those instances of successive contrast that are more pronounced, immediate, and local (i.e., involving only a portion of the visual field).

is a property of individuals and after-images are colored, then after-images must be individuals. This raises a few questions: What kind of individual is an after-image? In what ways is an after-image distinct from other colored individuals?

Boghossian and Velleman (1997), following Peacocke (1983), respond to the problem of after-imaging by positing a visual field with intrinsic sensational qualities. They argue that there is a sense in which an after-image *appears to you in* a certain location, but does not *appear to be in* that location in physical space. For example, when a photographer's flash produces an after-image, the after-image *appears* in front of the photographer without appearing to be *physically located* in front of the photographer. Boghossian and Velleman see the "only way to describe the after-image … is to talk about the location that it occupies in your visual field**"** (Boghossian & Velleman 1997, 92). Thus, an after-image is an individual, but an individual that is located exclusively in the visual field and never in the external world.

Tye (2000), on the other hand, rejects this response as it "smacks of the classical sense-datum theory" and seems to suggest that colors appear as properties of one's visual field rather than features of the environment (Tye 2000, 84). Instead, Tye appeals to a distinction between two kinds of *seeing*: non-conceptual (or phenomenal) seeing and conceptual (or epistemic) seeing. Tye analogizes the conflict of these two modes of seeing in after-imaging to the visual experience of a *trompe l'oeil* painting. In the same way that it is possible for a painting's content to appear simultaneously as three-dimensional in the non-conceptual sense and two-dimensional in the conceptual sense, it is possible for an after-image to appear simultaneously as being in the external world in the non-conceptual sense and not in the external world in the conceptual sense (Tye 2000,

86). If one considers visual experience in the non-conceptual/phenomenal sense, a red after-image may appear to be in front of a white wall. However, if one considers the same experience in the conceptual/epistemic sense, the after-image does not appear to be there. Thus, when we consider visual experience in terms of conceptual seeing, "there is a clear sense in which the basic experiences involved in seeing after-images are *always* illusory; for when one sees an afterimage, there is nothing that one sees" (Tye 2000, 84).

For both accounts, the solution to problems of after-imaging relies on drawing a theoretical distinction. For Boghossian and Velleman, it is a distinction between *visual field* and *external world*, and for Tye, between *non-conceptual seeing* and *conceptual seeing*. But these distinctions seem to raise no fewer issues than they resolve. In the former case, positing a visual field with intrinsic sensational qualities edges close to sense-datum theory and misrepresents the nature of visual experience. In the latter case, the distinction between conceptual and nonconceptual seeing is vague and relies on controversial assumptions about the nature of mind, namely, that visual experience is possible without concepts, that perceivers have conscious access to non-conceptual seeing, and that the contents of non-conceptual seeing can be easily identified.[10]

However, such distinctions are unnecessary once we remind ourselves what after-imaging actually is: a concentrated case of chromatic adaptation. The difference between chromatic adaptation and after-imaging is one of intensity, not kind. Chromatic adaptation can be gradual and global (i.e., involving the entire visual field), whereas after-imaging is always more immediate and local (i.e., involving a portion of the visual field). The interpretation of after-images as individuals strikes me as more a product of

[10] See McDowell (1994) and Peacocke (1998) for a discussion of the first two worries. See Siegel (2006) for a discussion of the third worry.

grammatical structure than phenomenology. When we want to talk about things we treat them as objects. If I want to talk about this phenomenon happening in my visual field, I give it a name—"after-image"—and this enables me to say something about it, e.g., "I see a red after-image." However, I think we should be cautious in making the move from language to ontology. There is clearly a sense in which after-images are quite unlike other colored objects, a fact that both Boghossian and Velleman (1997) and Tye (2000) recognize. I think we have difficulty wrestling the after-image into a framework of colored individuals not merely because the theoretical framework of colored individuals is lacking in some way, but because the term *individual* is inapplicable to after-images. An after-image is not perceived as an individual *out there* in the world, nor is it a startling hallucination that gives us cause to doubt the operation of our visual system; rather, it is a remnant of the process of ordinary seeing, a way of presenting the spectral and non-spectral properties in one's environment.

If we reject the claim that after-images are individuals, we no longer have to answer the questions "What kind of individual is an after-image?" and "In what ways is an after-image different from other kinds of colored individuals?" In their place, we face a more basic question: "What is an after-image?" To this, I respond that an after-image is *not* a thing which is colored—rather, it is color itself. An after-image is not an individual that *bears* color properties. There is no such thing as a *red after-image*, but more simply a *redness* or, more precisely, an event of seeing red-ly.

The perceptual pragmatist interpretation of after-images has a few advantages. First, it puts after-images on the same ontological footing as surface colors and synesthetic colors. All three colors are modes of presenting objective properties, and

there is no a priori reason to elevate one type of color to reality while degrading the others to illusion. Second, it accounts for why, in most cases, after-images should be considered illusory. Most after-images are misperceptions not because of their nature, but because they generally obstruct rather than enhance a perceiver's environmental interactions. Since colors are ways of seeing objects and after-images usually fail to help us see objects and complete visually guided tasks, we can, in most cases, regard them as illusory.

Conclusion

Perceptual pragmatism is the view that (i) colors are properties of interactions between a color perceiver and an external stimulus that induces color experience, and that (ii) perceptual states are correct insofar as they are useful to the perceiving organism. I have defended this view in regard to six main issues: phenomenology, perceptual variation, disagreement, illusion, common sense, and the usefulness of color vision. I have also argued that, compared to the other theories discussed, perceptual pragmatism offers the most complete account of synesthetic color.

In Part I, I discussed four prominent theories of color: physicalism, eliminativism, role functionalism, and sensory classificationism. Physicalism accords with the common sense view that objects are colored and provides us with an objective standard for adjudicating perceptual disagreements, but it has difficulty accounting for certain aspects of phenomenology (i.e., the unique-binary hue distinction and resemblance relations) and perceptual variation. Eliminativism can account for these aspects of phenomenology and perceptual variation, but in doing so it defies common sense, forfeits an objective standard for color judgments, and makes the usefulness of color vision difficult to explain. Role functionalism advances on most of these issues, but it lacks considerations of usefulness. Sensory classificationism responds well to all six issues, but its account of perceptual error prevents it from responding to issues of color synesthesia.

In Part II, I discussed perceptual pragmatism in relation to each of the above issues. In chapter 5, I introduced Chirimuuta's adverbialism and defended it against criticisms of perceiver-dependence, predication, and phenomenology. In chapter 6, I introduced Chirimuuta's views on the usefulness of color vision and defended its ability

to account for perceptual variation, disagreement, and illusion. By relativizing color to perceivers, perceptual pragmatism denies that there is an objective standard according to which we can identify the colors with physical properties. Therefore, perceptual pragmatism rejects the notion that there is an ideal perceiver with privileged access to the real colors, and is thus able to accommodate intersubjective and interspecies variation. By making usefulness the standard for the correctness of perceptual states, perceptual pragmatism allows for misperception, namely, in those cases in which one's color perception inhibits rather than enhances the visually guided tasks that the perceiver normally uses color vision to accomplish. Therefore, although colors are relative to perceivers, illusions and resolutions to some perceptual disagreements are possible on the perceptual pragmatist view.

In chapter 7, I argued that perceptual pragmatism offers the only satisfactory account of synesthetic color. Each of the other theories discussed either denies the existence of synesthetic color or ascribes synesthetic color properties to objects, a proposal that conflicts with both common sense and synesthetic experience. In contrast, perceptual pragmatism can both affirm the reality of synesthetic color and avoid ascribing synesthetic color properties to objects. I also revisited the objections leveled against Chirimuuta's adverbialism in chapter 5, arguing that these very points of criticism are points of strength for perceptual pragmatism once synesthetic color is considered.

In chapter 8, I addressed the common sense objection that colors don't look like properties of events. In response, I offered counterexamples from ordinary phenomenology and argued that phenomenology is agnostic as to whether colors appear as properties of individuals or events. I also argued that adopting a theory in which colors

are properties of events is advantageous for accounting for otherwise puzzling phenomena, such as chromatic adaptation and after-imaging.

In the introduction to this thesis, I said that my project was primarily motivated by the challenges color synesthesia poses to color ontology. As it stands, there is no theory of color that explicitly addresses synesthesia. This omission inspired three questions. First: how would the main theories in color ontology interpret synesthetic colors? Second: which, if any, of these theories would be able to treat synesthetic colors as being more than misperception? Third: what would be the costs of adopting such a theory?

In response to the first question, eliminativism and realism present us with three options, all of which, I've argued, are unsatisfactory. Eliminativism would deny that synesthetic colors are real, just as it denies normal colors are real. This is unsatisfactory for the same reasons eliminativism about normal color is unsatisfactory. Realism could either affirm or deny the existence of synesthetic colors. If the realist claims that synesthetic colors are real, then she would have to ascribe synesthetic color properties to objects. However, given the diversity of stimuli that induce synesthetic color, this would result in an extreme ontological excess. If the realist claims that synesthetic colors are not real, then she must offer reasons as to why synesthetic colors are illusory while normal colors are not. However, as I have argued, I do not believe such reasons exist.

In response to the second question, perceptual pragmatism is the only theory that can affirm the reality of synesthetic color, distinguish synesthetic color from normal color, and avoid the ontological excess of ascribing synesthetic color properties to external objects. This distinct ability is due to perceptual pragmatism's commitment to its two main theses. The first thesis—that colors are properties of interactions between a

color perceiver and an external stimulus that induces color experience—allows us to avoid the problems associated with treating synesthetic colors as properties of objects. Since colors are perceiver-dependent properties of interactions, synesthetic colors exist only where there are interactions between a synesthetic perceiver and the appropriate stimulus. The second thesis—that perceptual states are correct insofar as they are useful to the perceiving organism—allows us to recognize synesthetic color as being more than mere illusion. Unlike after-images, synesthetic colors seem to enhance rather than inhibit one's environmental interactions. Therefore, given their usefulness to perceivers, we can reject the claim that synesthetic colors are misperceptions.

In response to the third question, to accept perceptual pragmatism is to reject our common sense view of color. As I have argued in Part II, perceptual pragmatism can respond to concerns of phenomenology, perceptual variation, disagreement, illusion, and the usefulness of color vision; however, there is no way to reconcile the perceptual pragmatist claim that colors are properties of interactions with the common sense view that colors are intrinsic, non-relational properties of objects. At best one can argue, as I did in chapter 8, that not all colors look like properties of objects. But it is indisputable that most colors *do* look like properties of objects, that most of our color-talk reflects the view that colors are objective properties, and that treating an object's color as indicative of that object's properties generally enhances our ability to interact with our environment.

So this prompts a further question: should we adopt perceptual pragmatism? Or, in other words, is common sense a fair price to pay for having an account of synesthetic color? For non-synesthetes, the adverbial view violates common sense. For synesthetes, the common sense view of color is incomprehensible. The answer to this question rests

on deeper meta-philosophical issues of what we should value in a metaphysical theory, what the goals of metaphysical inquiry should be, and whether such goals are attainable. It is beyond the scope of my project to answer such questions here. But I have laid the options and their costs bare. Now it is up to the reader to decide which problems to privilege.

Bibliography

Allen, K. (2015). "Colour Physicalism, Naïve Realism, and the Argument from Structure." *Minds & Machines* 25.2: 193-212.

Baron-Cohen, S. (1996). "Is There a Normal Phase of Synesthesia in Development?" *Psyche* 2.

Baron-Cohen, S., L. Burt, F. Smith-Laittan, J. Harrison, & P. Bolton (1996). "Synesthesia: Prevalence and Familiarity." *Perception* 25.9: 1073-1079.

Blake, R. et al. (2005). "On the Perceptual Reality of Synesthetic Color." *Synesthesia*: *Perspectives from Cognitive Neuroscience*. Ed. L. Robertson and N. Sagiv. Oxford: Oxford University Press. 48-70.

Boghossian, P. & J. D. Velleman (1997). "Colour as a Secondary Quality." *Readings on Color*: *The Philosophy of Color, Volume 1*. Ed. A. Byrne and D. Hilbert. Cambridge: MIT Press. 81-103.

Briscoe, A. & L. Chittka (2001). "The Evolution of Color Vision in Insects." *Annual Review of Entomology* 46.1: 471-510.

Brogaard, B. (2012). "Colour Eliminativism or Colour Relativism?" *Philosophical Papers* 41.2: 305-321.

Byrne, A. (2003). "Color and Similarity." *Philosophy and Phenomenological Research* 66.3: 641-665.

Byrne, A. & D. Hilbert. (2003a). "Color Realism and Color Science." *Behavioral and Brain Sciences* 26.1: 3-21.

---. (2003b). "Color Realism Redux." *Behavioral and Brain Sciences* 26.1: 52-59.

Chalmers, D. (2006) "Perception and the Fall from Eden." *Perceptual Experience*. ed. T. Gendler and J. Hawthorne. Oxford: Clarendon Press. 49-122.

Chirimuuta, M. (2015). *Outside Color: Perceptual Science and the Puzzle of Color in Philosophy*. Cambridge, MA: MIT Press.

---. (2016). Interview by John Roman. *Rotman Institute of Philosophy*. http://www.rotman.uwo.ca/interview-with-dr-mazviita-chirimuuta/

Cohen, J. (2009). *The Red and The Real: An Essay on Color Ontology*. New York: Oxford University Press.

---. (2015). "Review of *Outside Color: Perceptual Science and the Puzzle of Color in Philosophy*." *Notre Dame Philosophical Reviews*. http://ndpr.nd.edu/news/61949-outside-color-perceptual-science-and-the-puzzle-of-color-in-philosophy/.

Eagleman, D. et al. (2007). "A Standardized Test Battery for the Study of Synesthesia." *Journal of Neuroscience Methods* 159.1: 139-145.

Gegenfurter, K. & D. Kiper (2003). "Color Vision." *Annual Review of Neuroscience* 26: 181-206.

Gray, R. (2001). "Synaesthesia and Misrepresentation: A Reply to Wager." *Philosophical Psychology* 14.3: 339-346.

Hardin, C. L. (1988). *Colors for Philosophers*: *Unweaving the Rainbow*. Indianapolis: Hackett.

Hilbert, D. (1987). *Color and Color Perception: A Study in Anthropocentric Realism*. Menlo Park, CA: Center for the Study of Language and Information.

Hurvich, L. M. (1981). *Color Vision*. Sunderland, MA: Sinauer.

Jackson, F. (1998). *From Metaphysics to Ethics*. Oxford: Clarendon Press.

Jacobs, G. H. (1993). "The Distribution and Nature of Colour Vision Among the Mammals." *Biological Reviews* 68.3: 413-471.

Johnston, M. (1997). "How to Speak of the Colors." *Readings on Color*: *The Philosophy of Color*, *Volume 1*. Ed. A. Byrne and D. Hilbert. Cambridge, MA: MIT Press. 137-176.

Landesman, C. (1993). "Why Nothing Has Color: Color Skepticism." *The Theory of Knowledge*: *Classical and Contemporary Readings*. Ed. L. P. Pojman. Belmont, CA: Wadsworth. 121-127.

Lehar, S. (2008). "The Constructive Aspect of Visual Perception." http://cns-alumni.bu.edu/~slehar/ConstructiveAspect/ConstructiveAspect.html

Lewis, D. (1997). "Naming the Colours." *Australasian Journal of Philosophy* 75.3: 325-342.

Locke, J. (1689). *An Essay Concerning Human Understanding*. Ed. P. Nidditch (1975). Oxford: Oxford University Press.

Malkoc, G., P. Kay, & M. A. Webster. (2005). Variations in normal color vision. IV. Binary hues and hue scaling. *Journal of the Optical Society of America* A 22 10: 2154-68.

Matthen, M. (1988). "Biological Functions and Perceptual Content." *Journal of Philosophy* 85.1: 5-27.

---. (2005). *Seeing, Doing, and Knowing: A Philosophical Theory of Sense Perception*. New York: Oxford University Press.

---. (2008) "*Seeing, Doing, and Knowing*: A Précis." *Philosophy and Phenomenological Research* 76.2: 392-399.

Maund, B. (1995). *Colours*: *Their Nature and Representation*. New York: Cambridge University Press.

---. (2011). "Colour Eliminativism." *Primary and Secondary Qualities: The Historical and Ongoing Debate*. Ed. L. Nolan. Oxford University Press. 362-385.

MacAdam, D. L. (1985). *Color Measurement: Theme and Variations*. 2nd revised edition. Berlin: Springer-Verlag.

Macpherson, F. (2007). "Synaesthesia, Functionalism, and Phenomenology." In *Cartographies of the Mind*. Ed. M. Marrafa, M. De Caro, and F. Ferretti. Dordrecht: Springer. 65-80.

McDowell, J. (1994). *Mind and World*. Cambridge, MA: Harvard University Press.

McGinn, C. (1996). "Another Look at Color." *The Journal of Philosophy* 93.11: 537-553.

McLaughlin, B. (2003). "The Place of Colour in Nature." *Colour Perception: Mind and the Physical World*. Ed. R. Mausfeld. New York: Oxford University Press. 475-500.

Mollon, J. D. (1989). "Tho' She Kneel'd in That Place Where They Grew…: The Uses and Origins of Primate Colour Vision." *Journal of Experimental Biology* 146: 21-38.

Nassau, K. (2001). *The Physics and Chemistry of Color: The Fifteen Causes of Color*. 2nd edition. New York: John Wiley & Sons.

O'Callaghan, C. (forthcoming). "Synesthesia vs. Crossmodal Illusions." *New Essays on Synaesthesia*. Ed. Ophelia Deroy. Oxford: Oxford University Press.

Pasnau, R. (2009). "The Event of Color." *Philosophical Studies* 142.3: 353-369.

Pautz, A. (2003). "Have Byrne & Hilbert Answered Hardin's Challenge?" *Behavioral and Brain Sciences* 26.1: 44-45.

--- (2006). “Can the Physicalist Explain Colour Structure in Terms of Colour Experience?” *Australasian Journal of Philosophy* 84.4: 535-564.

Peacocke, C. (1983). *Sense and Content*: *Experience, Thought, and their Relations*. Oxford: Clarendon Press.

---. (1998). “Nonconceptual Content Defended.” *Philosophy and Phenomenological Research* 58.2: 381-388.

Pokorny, J. et al. (1979). “Duration Thresholds for Chromatic Stimuli.” *The Journal of the Optical Society of America* 69.1: 103-106.

Ramachandran, V. S. & Hubbard, E. M. (2001). “Synaesthesia: A Window into Perception, Thought, and Language.” *Journal of Consciousness Studies* 8.12: 3-34.

Sagiv, N. et al. (2006). “What is the Relationship between Synesthesia and Visuo-spatial Number Forms?” *Cognition* 101: 114-128.

Sellars, W. (1975). “The Adverbial Theory of the Objects of Sensation.” *Metaphilosophy* 6.2: 144-160.

Siegel, S. (2006). “Which Properties are Represented in Perception?” *Perceptual Experience*. ed. T. Gendler & J. Hawthorne. Oxford: Clarendon Press.

Shevell, S. & F. Kingdom (2008). “Color in Complex Scenes.” *Annual Review of Psychology* 59: 143-166.

Thompson, E., A. Palacios, & F. J. Varela (1998). “Ways of Coloring: Comparative Color Vision as a Case Study for Cognitive Science.” *Language Form and Language Function*. Ed. F. Newmeyer. Cambridge, MA: MIT Press. 351-406.

Tye, M. (1995). *Ten Problems of Consciousness*: *A Representational Theory of the Phenomenal Mind*. Cambridge, MA: MIT Press.

---. (2000). *Consciousness, Color, and Content*. Cambridge, MA: MIT Press.

Wager, A. (1999). “The Extra Qualia Problem: Synaesthesia and Representationism.” *Philosophical Psychology* 12.3: 263-281.

Webster, M. (2003). “Light Adaptation, Contrast Adaptation, and Human Colour Vision.” *Colour Perception: Mind and the Physical World*. Ed. R. Mausfeld. New York: Oxford University Press. 67-110.

Yablo, S. (1992). “Mental Causation.” *Philosophical Review* 101.2: 245-280.