



Roberts, Pendaran (2014) Open your eyes: an essay on color ontology. PhD thesis, University of Nottingham.

Access from the University of Nottingham repository:

http://eprints.nottingham.ac.uk/14231/1/Open_your_eyes-An_essay_on_color_ontology.pdf

Copyright and reuse:

The Nottingham ePrints service makes this work by researchers of the University of Nottingham available open access under the following conditions.

- Copyright and all moral rights to the version of the paper presented here belong to the individual author(s) and/or other copyright owners.
- To the extent reasonable and practicable the material made available in Nottingham ePrints has been checked for eligibility before being made available.
- Copies of full items can be used for personal research or study, educational, or not-for-profit purposes without prior permission or charge provided that the authors, title and full bibliographic details are credited, a hyperlink and/or URL is given for the original metadata page and the content is not changed in any way.
- Quotations or similar reproductions must be sufficiently acknowledged.

Please see our full end user licence at:

http://eprints.nottingham.ac.uk/end_user_agreement.pdf

A note on versions:

The version presented here may differ from the published version or from the version of record. If you wish to cite this item you are advised to consult the publisher's version. Please see the repository url above for details on accessing the published version and note that access may require a subscription.

For more information, please contact eprints@nottingham.ac.uk

OPEN YOUR EYES: AN ESSAY ON COLOR ONTOLOGY

Pendaran Roberts

Thesis submitted to the University of Nottingham

for the degree of Doctor of Philosophy

July 2014

Abstract

This essay is an exercise in philosophy. It asks, “what are the colors?”, and ultimately provides a primitivist answer. The essay has four parts. The first is entitled “Stage setting” and has two subparts. In 1.1, I provide an explanation of how we should understand the question of which this essay is concerned. The goal of 1.2 is to provide an adequate taxonomy of views. Part 2 is entitled “Dispositional views” and has three subparts. In 2.1, I argue against appearance dispositional views. In 2.2, I argue against reflectance dispositionalism. Finally in 2.3, I provide a general argument against the colors being dispositions. Part 3 is entitled “Categorical views” and has three subparts. In 3.1, I argue against micro-structuralism. In 3.2, I argue against Cohen’s relationalism. Finally in 3.3, I argue for and defend non-relational primitivism. In the last major section of this essay I look at whether we should give up on the colors actually being instantiated. This section has only one subpart, and in it I reject the argument that the best explanation of mass disagreement about the colors is that irrealism is true.

Acknowledgements

I am indebted to my father. He is a man of great intellectual capacities and so understood why one might be tempted by such an esoteric question as “What are the colors?” Thus, he encouraged me to pursue my interests regardless of whether they were practical. He would say, “Many people work so they can do what they love; few love their work. So, if you love philosophy, then that is what you should do.” Whether that was good advice in the end has yet to be seen, but without it this essay certainly would not have been written.

In addition to my father, I am grateful to my wife Kelly. She sacrificed so that I would be able to work on a PhD in philosophy. She also, being very intelligent herself, contributed to the work I did. It is because of her statistical and scientific skills that I was able to do the experimental philosophy that constitutes a small portion of this work. There is no way I would have been able to do the statistics necessary on my own and without help.

Also, I am grateful to my amazing friends for just being who they are. My obsession with this project would sometimes hinder my ability to see the solution to a problem. It was only after taking a break to play video games with Link, or going to see a Movie with Ben M. and David, or talking to Greg on Facebook, or chatting about life with Hudson or Rob, or racing go-karts with Ben E. that I was able to get the fresh perspective I needed.

Last but not least, I am grateful to Philip Percival (my advisor throughout most of this project) and Harold Noonan (my secondary advisor for most of the project). Without them this essay, as it is today, would not have been possible. I am also grateful to

Jonathan Tallant, Stephen Barker, Keith Allen, and James Andow who all kindly commented on portions of this work.

Contents

	Preface	6
1	Stage Setting	10
	1.1 Getting Clear On The Question	11
	1.2 A Taxonomy of Views	17
2	Dispositional Views	47
	2.1 Against Appearance Dispositionalism	48
	2.2 Against Reflectance Dispositionalism	81
	2.3 A General Argument Against Dispositionalism	107
3	Categorical Views	136
	3.1 Against Micro-Structuralism	137
	3.2 Against Cohen's Relationalism	158
	3.3 In Defense of Non-relational Primitivism	237
4	Irrealism or Realism	285
	4.1 Against The Argument from Mass Disagreement.	286

Preface

The colors and physics

This essay is concerned with the question “What are the colors?” When talking with those who have not been educated in analytic philosophy (and also sometimes with some who have) it is not uncommon for someone to ask, “Hasn’t physics already answered that question? Are not the colors wavelengths of light?” My reply is always that in the vernacular the term “color” is used to pick out a property of external objects in addition to a property of light, and so the relevant use of “color” in physics should be understood as only being a technical term.

“But doesn’t physics tell us that nothing is actually colored?” Scientists sometimes seem to be under the impression that it has been discovered that nothing is actually colored. Their reasoning seems to be that one can explain our experiences as of objects being colored without needing to say that things are colored. It is true that one *can* provide a causal explanation for why we have color experiences without needing to posit colors. However, just because one can do this does not imply that nothing is actually colored. For example, just because one can explain why we perceive macro composite objects without needing to posit any macro composite objects does not imply that there are no macro composite objects. In the color case just like in the object case, what is needed is an argument to the effect that the irrealist hypothesis is preferable to the realist hypothesis. The construction of such an argument would be a philosophical endeavor not a scientific one. So, physics has not shown that nothing is colored.

Moreover, it is impossible to say whether nothing is colored until we know what it is that we are saying nothing has. Thus, physics could not have discovered that nothing is colored unless physicists already knew the answer to what it is that the colors are. Physicists do not know the answer to this question. Their use of “color” is irrelevant. Interestingly, if their use of “color” were relevant, physicists should hold that some things (i.e. light waves) are actually colored. Regardless, both of my interlocutor’s questions above must be answered in the negative.

The colors and philosophy

Is the world really the way it appears? A negative answer to this question (or at least more negative than not) has had a huge impact on the ontology of color. In the Essay, Locke famously says, “Let not the Eyes see Light or Colours [...] and all Colours [...], as they are such particular *ideas*, vanish and Cease, and are reduced to their Causes, i.e. Bulk, Figure, and Motion of Parts (2004, II-viii-17). This view that external objects are not *really* colored, or at least not really colored in the way that they are really square, was orthodoxy for a long time. However, it is no longer so obvious that such a secondary quality view is correct. There has recently been a revolution the result of which being that the secondary quality view now has many contenders. There are now myriad realist views on color from Byrne and Hilbert’s (2003a) reflectance physicalism to the increasingly popular simple view on color supported by Campbell (1997).

However, because of this revolution, it is even more obvious than it was before that philosophers do not agree on what the colors are. This is unfortunate. For an answer to the relevant question would be intrinsically interesting. Anyone who is disposed to ask

philosophical questions has at some point wondered about color. The world appears to be painted in rich greens, blues, reds, and so on. However, modern science fails to adequately say what it is that we are seeing when we see the green of the grass, the blue of the sky, and the red of the tomato. Thus, the philosophically minded is left to his own devices. This leads him to ask questions such as, “is the redness really in the tomato like its roundness is or is redness just a disposition of the object to create some effect in us?” As anyone who has been down this path knows such metaphysical questions are fascinating, difficult, and demanding of an answer.

An answer to what the colors are is also instrumentally important, because it would shed light on the nature of other properties classically classified as secondary qualities (e.g. smells, tastes, and sounds). In fact, I think it is even reasonable that an answer to what the colors are could shed some light on the enquiry into what beauty is. The reason why an answer to what the colors are would probably shed light onto what these other properties are is that the arguments used in the ontology of color are going to be relevant, at least to some degree, to the ontology of smells, tastes, sounds, and beauty. So, the enquiry into what the colors are is an exercise the merits of which are far reaching: An investigation into what the colors are is important to the ontology of secondary qualities in general as well as to meta-aesthetics.

The colors and this essay

This essay is mainly an exercise in philosophy. Philosophers attempt to answer hard metaphysical questions mainly by thinking about them. Some are skeptical about whether this philosophical method is a good one. There is no special reason to be skeptical. It is

undeniable that we know a lot about the world due to scientific investigation. However, without thinking about the world we are in there would be no science, and it is only in conjunction with a sharp mind that the results of experiments are meaningful. So, thinking about the world is a necessary part of any knowledge seeking activity.

Moreover, the colors are properties of objects of which we are familiar, and thanks to the work of Hardin (1988) and Thompson (1995) (amongst others) a great deal about color science has been made accessible to the non-scientist. Thus, I believe to be in the position to say something interesting about what the colors are.

This essay has four parts. The first is entitled “Stage setting” and has two subparts. In 1.1, I provide an explanation of how we should understand the question of which this essay is concerned. The goal of 1.2 is to provide an adequate taxonomy of views. Part 2 is entitled “Dispositional views” and has three subparts. In 2.1, I argue against appearance dispositional views. In 2.2, I argue against reflectance dispositionalism. Finally in 2.3, I provide a general argument against the colors being dispositions. Part 3 is entitled “Categorical views” and has three subparts. In 3.1, I argue against micro-structuralism. In 3.2, I argue against Cohen’s relationalism. Finally in 3.3, I argue for and defend non-relational primitivism. In the last major section of this essay I look at whether we should give up on the colors actually being instantiated. This section has only one subpart, and in it I reject the argument that the best explanation of mass disagreement about the colors is that irrealism is true.

Pendaran Roberts

University of Nottingham

Part 1: Stage Setting

In part 1, I shall set the stage for my enquiry into what the colors are. In part 1.1, I will clarify how one is to understand the question “What are the colors?” In part 1.2, I will provide a taxonomy of views on color to guide my enquiry.

Part 1.1: Getting Clear On The Question

Before one can start an enquiry into a subject, one must have some way of understanding the question being asked. Moreover, if one does a poor job of understanding the question to be investigated, then this is likely to cause problems down the road. So, in this brief, opening chapter, I want to spend some time on how we should understand the question with which I am concerned, i.e. the question, “What are the colors?” I shall first discuss how I think we should understand this question (section 1). Having done this, I will then look at how we ought to identify (or pick out) the properties with which I am concerned (section 2).

Section 1: Understanding the question

Philosophers have an intuitive grasp on what is meant by a metaphysical question like the one with which I am interested. However, there is seldom much time given to trying to get a better explicit grasp on what is being asked. I believe it is worth doing so, however briefly, because just how ambiguous the question is can be demonstrated by a humorous reply given by a friend: He said, “The colors are (1) Red, (2) Orange, (3) Yellow, (4) Green (5) ...” The wittiness of this answer comes from the fact that it is the result of purposely misinterpreting the question being asked, but what exactly is the question such that this answer is inappropriate?

There are a lot replies to the question “what are the colors?” that take the form “the colors are identical with...” that are not appropriate answers to this question as I understand it. My friend’s humorous answer above is one such example. There are others. For instance, it would be an inappropriate answer to say, “The colors are the properties of

which this essay is concerned,” or to say, “The colors are the properties that Tom likes.” There are also a lot of appropriate answers to my question (see part 1.2). For instance, saying, “The colors are dispositions to reflect certain proportions of incident light” is an appropriate answer, and so is saying, “The colors are primitive properties that we experience objects as having when having visual experiences.”

In order to get clear on what separates the above latter two replies from the former two it is important to distinguish between a reply to “What are the colors?” that *merely* tells us something(s) about them (a reply that only gives identifying conditions), and a reply that does more than this by telling us what the colors are (and includes no superfluous information) (a reply that gives identity conditions).¹ Identity conditions tell us what the entities are that are the colors. Identifying conditions, on the other hand, merely tell us a way to identify (or pick out) the entities that are the colors by telling us certain properties that the entities that are the colors have or by telling us that a certain phrase, for example, “the properties that Tom likes,” picks out the entities that are the colors. In order to understand this difference in types of replies to “what are the colors?” let us look at the analogous question, “what is beauty?” One could say that beauty is the property that a tropical sunset has, or that it is the property I long for. On the other hand, one could say that beauty is the disposition to cause pleasing aesthetic experiences in normal humans, or that beauty is a primitive property we experience when looking at beautiful things. These latter two answers give identity conditions, but the former two merely give identifying conditions. That is, the latter replies tell us what the entities are

¹ This distinction (or something a lot like it) has been made by Evans (1985), McDowell (1985), Wiggins (1987), and more recently emphasized by Watkins (2002).

that are the colors, and the former replies merely tell us a way to identify the entities that are the colors.

We are now in a position to understand the question “What are the colors?” The question is asking after the identity conditions for the colors. So, only replies that give identity conditions are appropriate answers to my question. Hence, it is neither appropriate to answer the question by saying, “The colors are the properties of which this essay is concerned” nor by saying, “The colors are the properties that Tom likes.” This is because neither of these answers is capable of giving us identity conditions for the colors; they only provide identifying conditions. Contrary to this, saying, “The colors are dispositions to reflect certain proportions of incident light” provides us with identity conditions and so does saying, “The colors are primitive properties that we experience objects as having when having visual experiences.”

Section 2: Identifying conditions

I have clarified that my question is asking after the identity conditions for the colors, but in order to even begin to answer my question we need some way of better identifying the properties with which I am concerned. Why is the phrase “the colors” insufficient for identifying the properties with which I am interested? The reason is that the meaning of “the colors” is ambiguous. Physicists, for example, use the phrase “the colors” to refer to certain wavelengths of light, but the vernacular usage of this term shows that the concept being expressed is also about certain properties of objects’ surfaces, not just wavelengths of light. Theoretical physicists use the term “color” to refer to a property of quarks and gluons related to the strong interaction in quantum chromodynamics. This property has

little to do with color in the vernacular sense. So, it is important that we give an identifying condition that is less ambiguous than “the colors.”

Identifying conditions are not created equal. The identifying condition that fills in the question “The colors are identical with ____?” with the “the properties Tom likes,” for instance, is a poor way of picking out the colors. First, it is only contingently true. Second, even if “the properties Tom likes” were made rigid, it would still be inadequate, because it is too indirect. One could not identify the colors using “The properties Tom likes” unless one already knew how to locate the colors. One may know that Tom likes these properties called “the colors” but be confused about how to locate these properties and so need further guidance. Thus, the best identifying condition should be as direct as possible so that one is not first required to locate the colors (or to know about things that are not the colors, e.g. Tom’s preferences) in order to understand what is being picked out. So, an identifying condition should comply with at least these two requirements: (1) The condition refers to the colors in every possible world (in which it refers at all), and (2) the condition, as much as possible, directly picks out the colors.

An identifying condition that appears to meet these criteria is to fill in the relevant question with (a) “the properties that make our vernacular claims about colored things true.” An obvious problem with this condition is that it is not as direct as one may like. People may be confused by the ambiguities mentioned previously, and so would have to sort through these first before this identifying condition would be useful. Thus, my preferred identifying condition with which to fill in the question “The colors are ____?” is (b) “the properties that we actually experience things as having when having visual experiences as of things being colored,” where “an experience as of a thing being

colored” is just an experience with *that* phenomenal character with which we are all familiar. To be clear, this condition is better than (a), because it more *directly points* to the properties we perceive with which I am concerned.

2. 1: An ambiguity?

Those who favor representationalist talk will interpret “the properties that we actually experience things as having when having visual experiences as of things being colored” as saying “the properties represented by the representational content of the relevant experiences.” This poses no obvious problem for my identifying condition. However, Shoemaker (1994) and Chalmers (2006) have argued for dual content theories. These theories hold that an experience as of red, for instance, has more than one content. Shoemaker (1994) believes that an experience as of red has two Russelian contents, one that involves redness and another that involves an “appearance property” that is distinct from but associated with redness. Chalmers (2006) thinks that an experience as of red has a Russelian content that involves what he calls “perfect redness” (a purely qualitative property) and a Fregean content that involves a certain functional role.

If either Shoemaker or Chalmers is right (or both), then my proposed identifying condition is ambiguous. So, assuming a dual content view, there are three options available.

- i. The colors are the properties represented by content A.
- ii. The colors are the properties represented by content B.

- iii. It is incoherent that there are colors; It is only coherent that there are those properties represented by A and those represented by B.²

My preferred identifying condition is (b) that the colors are those properties we experience objects as having when having visual experiences as of things being colored, where an experience as of something being colored is just an experience with *that* phenomenal character with which we are familiar. Hence, if Chalmers is right, then the properties with which I am interested are the Russelian contents that involve purely qualitative colors. So, if Chalmers is right, I say the colors are the perfect colors. If Shoemaker is right, then the properties with which I am interested are the Russelian contents that involve appearance properties. So, if Shoemaker is right, I say that the colors are appearance properties. If one likes option (iii), one can understand my inquiry to shift from being about the colors to being about the Russelian contents that involve appearance properties in Shoemaker's case and to the Russelian contents that involve purely qualitative properties in Chalmers'. So, given this perspective on how to handle my enquiry, if Chalmers is right, the colors* are the perfect colors, and if Shoemaker is right, the colors* are appearance properties. Having given a taste of how to respond to any ambiguities, I shall from here on assume that my identifying condition is unambiguous.

² It is important not to confuse iii with the claim that external objects are not actually colored. This is because iii is a much stronger claim. Option iii says that the whole investigation into what the colors is just confused. The reasoning would go something like this: The property of being red is identical with the property that we represent things as having when having experiences as of red. However, there are multiple properties that we represent things as having when having experiences as of red. One thing cannot be two. So, the property of being red is a logically impossible property and mutatis mutandis for the other colors.

Part 1.2: A Taxonomy of Views³

In this chapter, I provide a taxonomy of views on color. Regrettably, I believe that none of the taxonomies available are satisfactory. Without an adequate taxonomy, the inquiry into what the colors are is going to be much harder and more prone to confusion than it would be otherwise. So, in this chapter, I first examine the two newest taxonomies and explain why they are unsatisfactory. Specifically, I look at Brogaard's (section 1) and then Cohen's (section 2). One of the reasons I am unsatisfied with Brogaard and Cohen's taxonomies is that I find it implausible that dispositions are ipso facto relational properties. I provide an argument against this way of classifying dispositional properties (section 3). Having learned from the vices and virtues of Brogaard and Cohen's taxonomies, I provide a much-improved way of taxonomizing views on what the colors are (section 4). My taxonomy rules out certain views, clarifies others, and shows that there is an unnoticed view worthy of serious consideration.

Section 1: Brogaard's taxonomy

Brogaard (2010a) provides what she calls 'a category scheme for the colors.' Her category scheme suggests that order, family, genus, and species relations hold between positions on color. Brogaard's category scheme can be interpreted as follows:⁴

³ This chapter has been published with a longer introduction and a few other minor changes in *Synthese*. Please see Roberts, 2013. Also, the article is available online at <http://link.springer.com/article/10.1007%2Fs11229-013-0368-z>

⁴ Brogaard (2010a) does not consistently stick to her category scheme, but she has confirmed via written correspondence that the taxonomy I attribute to her captures her scheme.

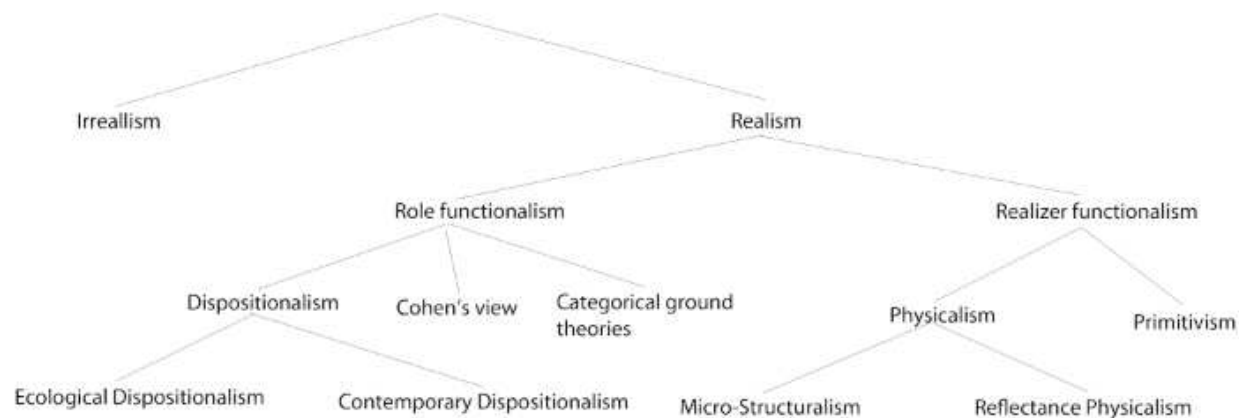


Figure 1.1: Brogaard's taxonomy

One can see from this figure that Brogaard (2010a) divides views on what the colors are into two orders: “irrealism” and “realism.” I understand realism to be the view that the colors are properties that are actually instantiated by external objects, and irrealism to be the view that the colors are properties that are not actually instantiated by external objects (Hardin, 1988; Chalmers, 2006). Under the realism node, Brogaard is best interpreted as holding that there are two families of views on color: role functionalism and realizer functionalism. The way I understand these nodes is that role functionalism holds that the colors are second-level properties of having properties that realize the appropriate roles, and that realizer functionalism is the view that the colors are the first-level properties that realize the appropriate roles. Brogaard would prefer to call the relevant nodes “relationalism” and “non-relationalism” respectively. I understand relationalism to be the view that the colors are relational properties and non-relationalism to be the view that they are non-relational properties. So, these terms cannot be substituted for the others, because there can be relational properties that are not role properties, for example, the property of being part of the device, the property of being identical with phosphorus, the property of being west of London, etc. I regard the nodes

immediately under realism as being captured by my definitions of role and realizer functionalism.

Brogaard specifies three role functionalist views: “dispositionalism,” “Cohen’s view,” and “categorical ground theories.” Dispositionalism has historically been intricately linked with the secondary quality view on color. Brogaard seems to understand dispositionalism in this narrow historical way. Roughly, she says that dispositionalism is the view that the colors are dispositions to give rise to phenomenal effects. However, given that today there are dispositional views like Byrne and Hilbert’s reflectance physicalism (see below) which differ substantially from the secondary quality view, it is preferable to understand dispositionalism in a broader sense. I understand dispositionalism broadly to be the view that the colors are dispositional properties akin to being fragile. Understanding dispositionalism in this way allows for one to see similarities and differences that would otherwise go unnoticed between views on color.

Cohen’s view, as I understand it, is that the colors are relational properties that construe the colors as being constituted by relations to subjects (possibly also amongst other things) (Cohen, 2004; 2009, p 9-10).⁵ More specifically, Cohen’s view can be cashed out as one according to which it is constitutive of (or essential to) any color L that there is a relation R such that for any object x , x is color L iff there exists an observer y (which need not be the same for different x ’s) such that x bears R to y (2004; 2009, p. 8-12, 24-36). (In section 4, I distinguish between two different species of Cohen’s view.) Cohen’s view is best captured as relationalist not role functionalist. It is first and

⁵ Cohen (2004; 2009) does not clearly differentiate between relations and relational properties. Relations are not the right type of things to be the colors. Objects can have colors, but they can only stand in relations. So, to be charitable I interpret Cohen as holding the view that the colors are relational properties not relations.

foremost obviously a relationalist view on color, and, as I said, there can be relational properties that are not role properties.⁶

Categorical ground theories hold that the colors are the categorical grounds of dispositions to cause certain phenomenal effects in perceivers if viewed (Jackson, 1996). In other words, categorical ground theories do not hold that the colors are dispositions to cause certain phenomenal effects but the categorical properties that ground or realize these dispositions. This view is most naturally understood as realizer functionalist not as role functionalist, because it says that the colors are the grounds or realizers of certain dispositions. A role functionalist understanding would require that one accept that the categorical grounds of the relevant dispositions are role properties, but role properties, unlike categorical ones, are understood in terms of causal powers. Notice that if we interpret the role functionalist node to be a relationalism node, this would result in Cohen's view being better categorized but would not ultimately improve things for two reasons: First, categorical ground theories neither fit well under a role functionalism node nor a relationalism node. As I said, categorical ground theories are best categorized as realizer functionalist. Second, I think it is implausible that dispositions are ipso facto relational properties (see section 3), and so it would be wrong to place a dispositionalism node (especially given my understanding) under a relationalism node.

It appears that Brogaard believes that there are two species of dispositionalism about color: "contemporary" and "ecological" dispositionalism. I understand contemporary dispositionalism to be the view that for any color C, C is identical with the disposition to cause certain experiences if viewed by a certain kind of perceiver in certain

⁶ Cohen (2009) ends up endorsing a role functionalist view, but this view is not identical with what is called "Cohen's view." According to Cohen, his role functionalist view is a *species* of what he calls "Relationalism." Cohen's view captures the idea of "relationalism" given in part 1.3 of his book.

conditions (usually qualified ‘by normal observers in normal viewing conditions’) (McGinn, 1983; Johnston, 1992). This view is the modern version of the secondary quality view famously endorsed by Locke amongst others. Ecological dispositionalism includes a series of views that are based on the ecological approach to zoology that insists the animal cannot be studied independently of its environment (Thompson, 1995; Noë, 2004). The most developed view of this kind is Noë’s (2004) theory that the colors are dispositions to modify how an object appears with respect to its color as the relevant conditions change.⁷ Thompson (1995, p. 242-250) also argues for an ecological view, although his view is poorly developed and has been argued to collapse into contemporary dispositionalism (Byrne and Hilbert, 2003, p. 7-8).

Brogaard specifies two genres of realizer functionalism: “physicalism” and “primitivism.” I understand physicalism to hold that the colors are physical properties like being H₂O or being atomic element 12. I understand primitivism to hold that the colors are non-reducible or *sui generis* (Yablo 1995; Westphal, 2005). That is, in contrast with the property of being water, which is often thought of as being reducible to the property being H₂O, primitivism holds that the colors are properties such as being square, which is thought of as being irreducible. It is important to emphasize that the sense of “primitive” I just characterized is such that “primitive” is not synonymous with “simple.” Primitive properties in my sense can be complex. The way I understand things, the property of being a square is a primitive property even though it is composed of four sides of equal length. The property of being square is primitive in that it cannot be

⁷ The view I cite to Noë above is similar to the one Brogaard cites to him. However, Noë’s view is far from clearly presented, so unsurprisingly, the view that Allen (2009) cites to Noë is not unambiguously the same view that I cite to him. Allen’s interpretation can be considered Noë’s view*. What is Allen’s interpretation? He says that according to Noë the colors are patterns of organization in how things look (p. 648-649).

reduced to any other property. The sense of “primitive” under which it means non-reducible better maps onto how primitivists about color comprehend their view than the understanding under which the term means simple. Primitivists about color have never felt the need to deny that binary colors, unlike unitary colors, are composed out of other colors.

A concern at this point is that Brogaard only places physicalism under the realizer functionalist node. However, there can be physical role properties (e.g. the property of being a transistor, the property of being a magnet, the property of being a jet engine, etc), at least under any broad conception of the physical like supervenience physicalism (Jackson, 1993; Chalmers, 1996). Brogaard divides the physicalism node into two species of view: “micro-structuralism” and “reflectance physicalism.” Micro-structuralism is the view that the colors are identical with particular micro-structural properties (Smart; 1963; Armstrong, 1968). Reflectance physicalism is the view that the colors are identical with dispositions to reflect certain proportions of incident light at each wavelength of the visible spectrum (Tye, 2000; Byrne & Hilbert, 2003; 2004). An obvious concern here is that reflectance physicalism is a dispositional view on color as well as a physical view, but because of Brogaard’s narrow conception of dispositionalism her taxonomy forces us to put it on the physicalism node. It would be preferable if a taxonomy of views on color could express that reflectance physicalism is a dispositional view.⁸

⁸ Brogaard’s taxonomy differentiates between reflectance physicalism and the views under her dispositionalism node like this. Reflectance physicalism holds that the colors are realizer functionalist, whereas the views under the dispositionalism node holds that the colors are role functionalist. This is an odd way of differentiating these views given how I understand them, because reflectance physicalism being dispositionalist is not naturally understood as a first-level view. Dispositions are naturally understood as second level. One could distinguish between different stages of the second level, but this seems as if it would get confusing fast.

Perhaps this issue has made explicit a problem I have so far left implicit: Many of Brogaard's same-level nodes are *prima facie* compatible with each other. Brogaard has a unique primitivism node, but there can be primitive physical properties as well as non-physical primitive properties. Also, Brogaard has a unique categorical ground theories node, but this view neither rules out physicalism nor primitivism. The categorical grounds of the relevant dispositions can be physical or primitive properties. Third, Brogaard has a unique physicalism node, but one can have physical primitive properties and physical dispositional properties, at least under any broad conception of the physical. Some of these problems, along with the issue of placing physicalism only under the realizer functionalist node, could be addressed by providing a narrow definition of "physical." Brogaard seems to have some narrow sense of the physical in mind. However, it is unclear whether a narrow definition of "physical" could draw a principled distinction between views on color. An underlying problem is that the notion 'physical' is difficult to get a handle on (Hempel, 1970; Crane & Mellor, 1990; Gocke, 2009).⁹ For this reason, it is best not to taxonomize views on color using the concept (Cohen, 2009, p. 6-7).

⁹ Carl Hempel (1970) has argued that a theory-based conception of the physical cannot succeed. The problem he says is that the conception is either trivial or false. If physicalism is understood in terms of contemporary physics, then the theory-based conception is false. Contemporary physics is obviously not complete. If physicalism is comprehended in terms of a future or ideal physics, then the theory-based conception is trivial. We cannot presently know what is of interest to a future or ideal physics. Such a physics may contain ectoplasm.

The theory-based conception of the physical is popular today regardless, but the modern version uses a rather broad understanding of 'physical.' The modern version of the theory-based conception says roughly that a property is physical iff it is either the kind of property that physics tells us about, or it is a property that metaphysically or logically supervenes on the kind of property that physics tells us about (Smart, 1978; Lewis, 1994, Braddon-Mitchell and Jackson, 2007, p. 19-34, Chalmers, 1996, p. 71-92). Given this version, the notion of 'physical' is so broad that it does not make for a particularly useful way of taxonomizing views on color.

There are three more problems with Brogaard's taxonomy worth mentioning. First, Brogaard does not metaphysically justify her taxonomic hierarchy. What would metaphysically justify Brogaard having role functionalism and realizer functionalism as her penultimate nodes instead of primitivism and non-primitivism, or what would metaphysically justify her having primitivism and non-primitivism over dispositionalism and non-dispositionalism? Perhaps answers to questions like these are of little practical importance, which is likely why Brogaard did not engage with them. However, this just goes to show that one should not accept the added complexity of hierarchical models without metaphysical support. Second, although I am unsure whether Brogaard intended her taxonomy to be exhaustive of logical space, it would be better if a taxonomy made it clear that there is logical room for undefended views.

Third, Brogaard's taxonomy suggests that all the views that fall under the realist node are incompatible with irrealism, but this is wrong. It is coherent to hold that being red is a primitive property or a physical property, perhaps micro-structural, that nothing actually has. The reason why these views are compatible with irrealism is that the enquiry into what the colors are can be understood as one into the properties we have experiences as of things having when having visual experiences as of things being colored, and there can be an answer to what we are having experiences as of even if nothing is actually colored (see section 4). Another way of looking at this is that the colors are the properties that could make our experiences as of things being colored veridical, and there can be an answer as to what could do this even if nothing is actually colored. With this being said, when one considers that objects appear colored to us, Cohen's view and contemporary dispositionalism *prima facie* look to be incompatible with irrealism. For Cohen, roughly,

if an object appears red, then it is (see section 4), and for contemporary dispositionalism, if an object appears red to a certain kind of perceiver in certain conditions (usually qualified “normal observers in normal viewing conditions”), then it is.

Section 2: Cohen’s taxonomy

Cohen (2009) proposes what he considers to be a refined taxonomy of positions on what the colors are. His taxonomy says that order, family, genus, and species relations hold between philosophical views on color as follows (2009, p. 13):

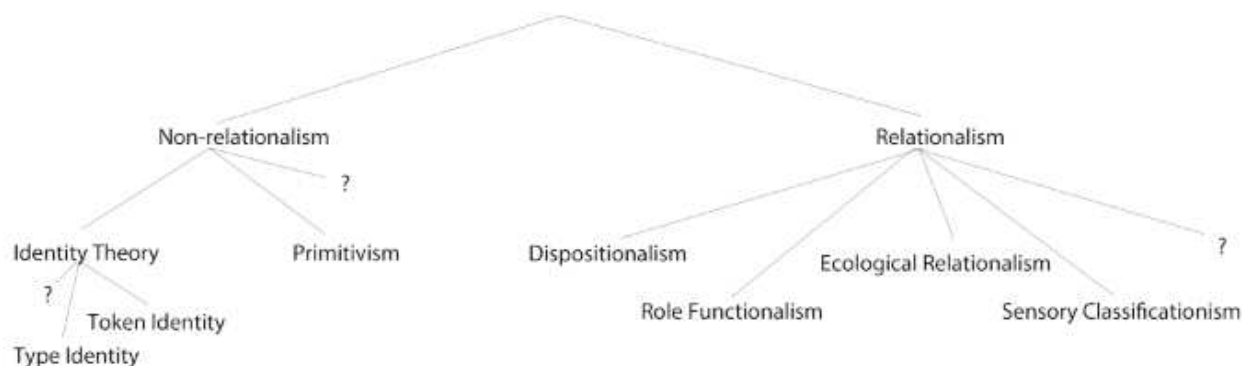


Figure 1.2: Cohen’s Taxonomy

Cohen splits views on color into two orders: “non-relationalism” and “relationalism.” Cohen’s relational node is narrower than the role functionalist node used in Brogaard’s taxonomy, at least as I understand her node. This is because Cohen says a view falls under the relationalism node iff it says that the “colors are constituted in terms of relations to subjects [possibly inter alia]” (2009, p. 10). Thus, Cohen’s relationalism node seems to be (basically) identical with “Cohen’s view” as I understand it in Brogaard’s taxonomy. In addition to this disparity in terms, two more disparities are worth mentioning. First, what Cohen (p. 13) calls “ecological relationalism” is the same as “ecological dispositionalism” with one caveat: Cohen only talks about Thompson’s

(1995) ecological view and does not mention Noë's (2004) view. Second, what Cohen calls "dispositionalism" is the same as "contemporary dispositionalism." This use of "dispositionalism" has the immediate anomalous consequence that reflectance physicalism is not dispositionalist. Cohen seems to be using the term "dispositionalism" in a historically narrow way, but, as I suggested in section 1, I think that this use is outdated given the assortment of views now available.

Physicalism, micro-structuralism, reflectance physicalism, and categorical ground theories are not nodes in Cohen's taxonomy. Cohen agrees with me that the notion 'physical' should be avoided, because it is unclear what condition a property has to satisfy to be physical (2009, p. 6-7). Cohen would place categorical ground theories under the non-relationalism node his taxonomy (p. 187). Cohen describes his "identity theory node" as involving views that say the colors are identical with microphysical properties or with non-subject involving functional kinds (p. 12). Cohen's "type identity" node includes views that hold the colors to be microphysical types (p. 3). "Token identity" views according to Cohen hold that "there is no one physical constitution type that is shared by all instances of a given color [...], but every token instance of a given color is a member of some or other physical type that affects light in the requisite way" (p. 3). Given the analogy that Cohen (p. 3) draws with token identity views in the philosophy of mind, I interpret the above quote as saying that a token identity view on color holds that for every particular instance of a color 'having a color x ' there is a particular physical instance 'having a property y ' such that having $x =$ having y , but there is no one physical property type that all having's of x share in common. Cohen places

reflectance physicalism under the token identity node and micro-structuralism under the type identity node.

In addition to the above differences, Cohen adds two more nodes that are not to be found in Brogaard's taxonomy. Cohen calls the first such view "role functionalism." Despite the fact that Brogaard also has a node by this name, Cohen's role functionalism node is narrower than how I understand Brogaard's: Cohen defines the C role as the functional role of disposing the bearer of the functional property to look red to a subject in a circumstance (2009, p. 178), while I understand Brogaard's node to leave the C role open. The second new node that Cohen adds he calls "sensory classificationism." He attributes a view of this kind to Matthen (2005). Cohen (2009, p. 229) says, "sensory classificationism construes colors in terms of relations between [...] objects [and] the sensory classifications made by subject's visual systems." He says the appropriate classifications are those according to a telos given by Matthen (2005, p. 230). I am unsure whether this is the correct interpretation. Cohen seems to think that Matthen's view is that colors are relations which hold between objects and sensory classifications. However, Egan (2008, p. 408) says the view is that the colors are dispositions to "produce [...] 'epistemic actions,' [where] epistemic actions include coming to have a perceptual belief, or making further classifications or generalizations." Perhaps there are also other interpretations.

Cohen's taxonomy avoids some of the issues with Brogaard's, because it does not have a high-level split between realism and irrealism and does not have a physicalism node or a categorical ground theories node. Also, it is worth mentioning that Cohen's taxonomy makes it clear that there are possible unspecified views. Unfortunately, it

should be obvious that Cohen's taxonomy makes at least two mistakes that are similar to errors discussed previously. First, Cohen provides no metaphysical justification for his taxonomic hierarchy over the many alternatives. What would metaphysically justify his having non-relationalism and relationalism as his top-level nodes instead of non-primitivism and primitivism, or what would metaphysically justify his having non-primitivism and primitivism over non-dispositionalism and dispositionalism? We should not accept the added complexity of a hierarchical model without metaphysical justification for it. One can give the non-relationalism/relationalism distinction a prominent role in a taxonomy on color like Cohen wants without using a hierarchical model.

Second, Cohen places contemporary and ecological dispositionalism (or "dispositionalism" and "ecological relationalism" given Cohen's terms) under the relationalism node of his taxonomy, but this placement is unintuitive. Certainly contemporary dispositionalism is intuitively not a relational view on color. One may retort that this view construes the colors as constituted by relations to subjects (Cohen, 2009, p. 11), but this would be misguided. Either something can be disposed to cause experiences as of yellow if viewed by a certain kind of perceiver in certain conditions if no perceivers exists or it cannot. Intuitively, something can be so disposed even if no perceivers exist. If this is right, contemporary dispositionalism cannot construe the colors as constituted by relations to subjects. Noë's view also seems as if it is non-relational. The view certainly cannot be understood to construe the colors as constituted by relations to any conditions. Something can be disposed to change how it appears with respect to color as certain conditions change even if the relevant conditions do not happen to obtain

(i.e. exist). If Thompson's view collapses into contemporary dispositionalism, it too would intuitively not be a relational view. I further support the intuition that these dispositions are not relational in section 3 by arguing that dispositions are not ipso facto relational properties.

There are four other problems with Cohen's taxonomy that are best discussed at this juncture in some depth. The first problem results from failing to realize that there can be primitive relational properties, given the sense of 'primitive' under which the term means non-reducible that I endorse and Cohen (2009, p. 4) seems to endorse. Cohen only places primitivism under the non-relationalism node of his taxonomy, but there is no obvious reason why there cannot be relational views on color that are also primitivist (whether relational views are understood in Cohen's restricted sense or not). After all, there can certainly be primitive properties that are also relational. For example, the property of being in love is plausibly a primitive relational property. Likewise, the relation 'in love with' is probably also primitive. Even if being in love and the relation 'in love with' are reducible, this is not obvious. The same goes for other relational properties like being west of London, being above the sink, etc. So, there is no clear reason why the colors cannot involve primitive relational properties (whether or not they involve subjects). Hence, Cohen's taxonomy ought not to rule out such views.

The second problem results from failing to realize that one of the nodes in Cohen's taxonomy is not exclusive. Specifically, the issue is that Cohen places his role functionalism about color on one of his lowest level nodes, but this view, as far as I can tell, can be true as well as contemporary dispositionalism. Cohen defines the functional role relevant to his role functionalism as that of disposing the bearer of the functional

property to look red to a subject in a circumstance. However, under this definition of the C role, the second-level property of having some or other first-level property that realizes this role looks a lot like the (constituted) disposition to appear red if viewed by a subject in a circumstance. Hence, as far as I can tell, Cohen's role functionalism is at least a species of contemporary dispositionalism and may even be identical with it. So, Cohen's version of role functionalism appears as if it should not be placed on a taxonomy as a separate species of view from contemporary dispositionalism.¹⁰

The third problem results from not properly understanding reflectance physicalism. Cohen (2009, p. 3) says that micro-structuralism is a type identity theory but claims that reflectance physicalism is a token identity view. He is right about micro-structuralism. However, assuming that Cohen understands token identity views analogously to the philosophy of mind literature, he is wrong about reflectance physicalism. Byrne and Hilbert, the main proponents of reflectance physicalism, hold that the colors are dispositions to reflect incident light at each wavelength of the visible spectrum (2003, p. 9). This is a type identity view; it says, for example, that the property being red is identical with the disposition to reflect R proportions of light at each wavelength of the visible spectrum.¹¹ Byrne and Hilbert later retreat to the position that the colors are types (or sets) of dispositions to reflect certain proportions of incident light, or as they say, "[...] Both determinable and determinate colors are reflectance types"

¹⁰ To be fair, Cohen (2009, p 11, footnote 18) says that contemporary dispositionalism may collapse into role functionalism. If there is such a collapse, it seems to me that it would go in the opposite direction, because contemporary dispositionalism provides a more fundamental answer to "what are the colors?" than role functionalism. Role functionalism provides a rather indirect way of saying what the colors are.

¹¹ Notice that whether reflectance dispositions are physical types (Cohen, 2009, footnote 4) is irrelevant to whether reflectance physicalism is a token identity view. Reflectance physicalism proposes a type reduction of the colors. So, if reflectance dispositions were not physical types, then this would only imply that reflectance physicalism is a non-physical type identity view. It would not imply that it is a token identity view.

(2003, p. 11). However, this view is also not a token identity view (in the philosophy of mind sense); it says that the property red, for instance, is identical with a *type* of disposition to reflect certain proportions of incident light rather than the specific dispositions to reflect light themselves. A token identity view, on the other hand, implies the falsity of such type identity claims.

The fourth problem with Cohen's taxonomy results from not properly distinguishing between the questions "what are the colors?" and "what are the particular instances of the colors?" Assuming Cohen understands token identity views the way I think he does, he should not place them on a taxonomy of views on what the colors are. Token identity views do not tell us what being red is but only what each particular instance of redness is. So, token identity views (in the philosophy of mind sense) should not be on a taxonomy of views on what the colors are. One may retort that a token identity view implicitly provides a response to the question "what are the colors?" to the effect that it cannot be answered. In reply, we are taxonomizing positions on what the colors are. Thus, a rejection of this question is a view to be considered but not taxonomized. One should not underestimate the importance of this point: If token identity views are understood to implicitly reject the question "what are the colors?", then putting them on a taxonomy of views on what the colors are is likely to lead to confusion in the future.

Section 3: Dispositions are not relational properties

When assessing Brogaard and Cohen's taxonomies I claimed that it is implausible that dispositions are ipso facto relational properties. This may be controversial, because many

have utterly failed to differentiate between these properties (McGinn, 1983; 1996; Thompson, 1995; Byrne & Hilbert, 2003; Noë, 2004). We have already seen some signs of this when discussing the taxonomies above. Now, let us look at some obvious and specific examples. First, Thompson (1995, p. 242-250) when talking about his ecological view vacillates between saying that the colors are dispositional properties and saying that they are relational properties with no sign that he recognizes a distinction. Second, Byrne and Hilbert (2003, p. 8) seem to agree with Thompson that dispositions are relational properties. Finally, Noë, like Thompson, moves between saying that the colors are dispositions (2004, p.144) and saying that they are relational properties (p. 149) with no sign that he is aware that these properties are different in nature. I shall now argue that dispositions are not ipso facto relational properties.

Roughly, my argument goes like this. (a) It is essential to relational properties that an object having one bears a relation to something(s), and (b) it is not essential to dispositional properties that an object having one bears a relation to something(s). To present my argument, I shall first explain why (a) is true and then (b). There are positive and impure relational properties (Khamara, 1988). The property of being married is an example of the former. This property is biconditionally dependent on the relation 'married to' such that a person x is married at time t iff x is married to someone at t . The property of being married to Tom is an example of the latter. This property is such that a person x has the property being married to Tom at time t iff there is an individual Tom and x is married to him at t . (Notice that Cohen's view discussed in section 1 is that the colors are positive relational properties like being married.)

A general analysis of both these kinds of relational properties seems *prima facie* to run as follows (Humberstone, 1996, p. 211):

General analysis: A property P is relational iff there is some relation R such that for all x , x has P at t only if for some thing(s) $y_1...y_n$, $Rxy_1...y_n$ at t .

However, Humberstone (1996, p. 211-212) argues correctly that there are some issues with this general analysis. The conditional ‘if x has P at t , then for some thing(s) $y_1...y_n$, $Rxy_1...y_n$ at t ’ comes out as vacuously true for impossible properties, and all objects regardless of their properties bear the identity relation to themselves. These issues with the general analysis can be addressed easily enough by rewriting it as follows:

Improved analysis: A property P is relational iff there is some relation R such that it is essential to P that for all x , if x has P at t , then for some thing(s) $y_1...y_n$, $Rxy_1...y_n$ at t .¹²

If the improved analysis is correct, then (a) follows. That is, it follows that it is essential to relational properties that an object having one bears a relation to something(s).

I now want to argue for (b) that it is not essential to dispositional properties that an object having one bears a relation to something(s). Intuitively, dispositional properties like the disposition to cause experiences as of red if viewed by a certain kind of perceiver in certain conditions are not relational properties. It does not seem essential to an object being disposed to cause experiences as of red if viewed by a certain kind of perceiver in

¹² Khamara (1988) gives analyses of positive and impure relational properties using the notion of ‘consisting in.’ The improved analysis could be stated with this notion as well. Humberstone (1996) provides a way of understanding the notion of ‘consisting in.’ The improved analysis could also be stated using the notion of ‘constitution.’ Cohen (2004; 2009) holds that relational properties are constituted by relations.

certain conditions that it bear a relation to anything. It certainly does not seem that an object being so disposed requires any perceivers to exist. Conversely, it is essential to something having the relational property being west of London, for example, that it bear the relation 'west of' to something, namely London. So, why would anyone hold that dispositions are ipso facto relational properties? The only motivation I can think of is to explain why an object x having the disposition to M in C gives it the connection it has with the counterfactual 'if x were in C , x would M '.¹³ The relationalist about dispositions answers this question as follows:

Relational option: For any object x , its having a disposition to M in C gives it the connection it has with the counterfactual 'if x were in C , x would M ,' because for every disposition to M in C there is some relation R such that it is essential to that disposition that any object which has it bears R to something(s).

There are two versions of the relational option: One in which R is a first order relation and one in which R is a second order relation. A relation R is second order iff at least one of R 's relata is a property and first order otherwise. The first order relationalist will say that for every disposition to M in C there is a first order relation R^1 such that it is essential to the disposition that any object which has it bears R^1 to the states of affairs x having M and x having C . The second order relationalist will say that for every disposition to M in C there is some second order relation R^2 such that it is essential to the disposition that any object which has it bears R^2 to the properties M and C . (As an object

¹³ As the simple conditional analysis of dispositions is unpopular, it is unclear how exactly dispositions are related to counterfactuals. See Johnston (1992), Bird (1998), and Martin (2008) for arguments against the simple conditional analysis. However, even though the simple conditional analysis is unpopular, basically everyone agrees that there is some connection between dispositional properties and counterfactuals.

cannot bear a relation to something that does not exist, these options commit one to some heavy duty metaphysics about non-actual states of affairs and uninstantiated properties. I ignore this issue here, because I take it that anyone who is willing to accept one of these options will also be willing to accept such consequences.)

An excellent concern is that these relational options are not relational in the right way. The improved analysis understands ‘relational property’ partly in terms of a relation holding between some things(s). The first relational option understands dispositions as involving relations to states of affairs, and the second relational option understands dispositions as involving relations to properties. Thus, more specifically, the worry is that states of affairs and properties are not things in the relevant sense; that is, they do not fall within the scope of the first order quantifier (used in first-order logic). This worry shows that the two relational options above are not relational in a strict sense. Even if one of the options turned out to be correct, dispositions could not be said to be ipso facto relational in the strict sense that, for example, the property of being married can be said to be. Nevertheless, if one of the options were correct, dispositions could be said to be ipso facto relational in a more liberal sense.

I think that both relational options are problematic even when understanding ‘thing’ in the liberal sense required by them. The distinction between the two versions of the relational option is not relevant to my argument, so I will just talk of a relation R , and of M and C . My argument is that the relational option should be rejected, because it fails to explain the relevant connection. The reason is that the relation postulated by the option does no explanatory work: There is no reason why R holding between x , M , and C should metaphysically determine that an object x having the disposition to M in C bears the

connection in question to the counterfactual ‘if x were in C , x would M .’ Why is it that $R(x, M, C)$ being essential to an object having the disposition to M in C metaphysically determines that the object has some connection with the counterfactual ‘if x were in C , x would M ’? There certainly does not appear to be anything in R ’s internal makeup that ensures that it would have this power. So, what is it that keeps the counterfactual ‘if x were in C , x would M ’ glued to $R(x, M, C)$?

Those who believe that dispositions are ipso facto relational properties may try to answer this question in one of two ways. First, one may say that it is just a brute fact that $R(x, M, C)$ gives an object x the connection it has with ‘if x were in C , x would M ’. The problem with this answer is that it is the brute fact that is doing the real work not $R(x, M, C)$. So, the relation postulated by the relational option is explanatorily superfluous. Second, one may try to explain what keeps ‘if x were in C , x would M ’ glued to $R(x, M, C)$ by positing a relation R^* that holds over R and (x, M, C) . The problem with this answer is that, similarly with R , there is no reason why $R^*\{R, (x, M, C)\}$ should metaphysically determine that $R(x, M, C)$ should metaphysically determine that if an object x has the disposition to M in C , then it has some connection with the counterfactual ‘if x were in C , x would M .’ One can just rinse and repeat all the way up so to speak. So, this second way of trying to address the problem, just like the first, does nothing to tackle the concern: The relation postulated by the relational option fails to do the work that it was postulated to do. Thus, the relational option should be rejected. So, we should accept (b) that it is not essential to dispositions that an object having one bears a relation to something(s).

A corollary of this is that the following must be true:

Non-relational option: Whatever the explanation is for why it is the case that for any object x , its having a disposition to M in C gives it the connection it has with the counterfactual ‘if x were in C , x would M ,’ the answer is *not* that for every disposition to M in C there is some relation R such that it is essential to that disposition that any object which has it bears R to something(s).

One salient way of choosing this option is given by Bird’s view. Bird (2007) would say that what explains the connection is that dispositions are constituted by the modal role endowing stimulus-responses relations that they bear to other properties. To be clear, dispositions are constituted by relations for Bird, but it is not the case for him that it is essential to an object’s having a disposition that it bear a relation to something(s). So, Bird’s view is a non-relational option. Armstrong (1983) would also choose the non-relational option by saying that the connection is explained by his second order necessitation relation that holds between properties.¹⁴ Another option would be to say that the Simple Conditional Analysis (SCA) (or something like it) explains the connection: Necessarily, x is disposed to M in C iff if x were in C , then x would M . The SCA is unpopular today, so this option is unlikely to have many supporters. However, it is *an* option. There is room for other versions of the non-relational option, but it would take us too far afield to explain them in depth or any of the versions for that matter.

¹⁴ There is a concern that arguments similar to the second one I raised against the relational option (i.e. the argument to the effect that the relation postulated by the option does no explanatory work) will apply to Bird and Armstrong’s views (Barker & Smart, 2012; Barker, 2013), but such discussion is outside the scope of this article.

Section 4: My taxonomy

Having learned from the virtues and vices of both Brogaard's taxonomy as well as

Cohen's, I propose the following taxonomy:

Dispositional	Relational	Reductive	Views on what the colors are
No	No	No	Non-relational primitivism
No	No	Yes	Micro-structuralism, Disjunctive micro-structuralism, Type (or set) reflectance dispositionalism, ???
No	Yes	No	Relational primitivism
No	Yes	Yes	Cohen's view 1 and 2, ???
Yes	No	No	Not available
Yes	No	Yes	Appearance dispositionalism, Reflectance dispositionalism, ???
Yes	Yes	No	Not available
Yes	Yes	Yes	???

Table 1.1: My Taxonomy

I do not think that there is good metaphysical reason to accept the added complexity of a hierarchical taxonomy. So, according to my taxonomy, views on color are grouped according to three characteristics: dispositional/non-dispositional, relational/non-relational, and reductive/non-reductive. Dispositional properties connect objects with counterfactuals in a special way that non-dispositional properties (also called 'categorical properties') do not.¹⁵ So, if the colors are dispositions, one must hold that they give objects a special connection with counterfactuals. The reflectance dispositionalist, for example, must say that a colored object has a special connection with

¹⁵ This special connection is described by my analysis of dispositional properties presented in part 2.3. Essentially, x is disposed to M in C iff non-circularly if x were in C , x would M .

‘if it were illuminated, it would reflect certain proportions of incident light at each wavelength of the visible spectrum’. Although categorical properties may not all be structural like shape properties are, it is natural for a color categoralist to understand the colors similarly to shapes and say that what it is to be colored is to have a certain structure. A categorical primitivist could point to the structure of the familiar color solid, and a categorical reductivist, for instance, to some micro-physical structure described by physics or chemistry.

A view is relational iff it says that the colors are relational properties. I presented my improved analysis of relational properties in the last section. Further, I argued that dispositions are not ipso facto relational properties. So, one cannot say that dispositional views are relational views. This will be a surprising consequence for those who have conflated these properties. However, absent a good response to my argument in the last section, one should accept its conclusion. Also, it should be clear from what I have said that some relational properties are not dispositional. Being left of London, for example, is clearly not a dispositional property of any kind. Hence, it is possible for there to be relational views on color that are also categorical. This shows that, although arguments for dispositional monism (Mumford, 2004; Bird, 2005a; 2005b; 2007) may count against certain relationalist views, arguments for categorical monism (Armstrong, 1997) need not rule out relationalism about color.

A view is reductive iff it says that a property picked out in one domain of enquiry is identical with a property in another and non-reductive (also called ‘primitivist’) otherwise. My identifying condition (part 1.1) provides the domain of enquiry for color. In the case of color, the domain of enquiry comprises the properties that we have

experiences as of objects having when having visual experiences as of objects being colored. Given this way of defining the domain, the reductivist says that the colors are identical with properties in a domain like that of the physical sciences or any other domain separate from the phenomenological one we are accustomed to in visual experience, while the non-reductivist denies this. Notice that given how I define the domain of enquiry there is no issue with there being an answer to “what are the colors?” even if nothing is colored. There can be an answer to what the properties are that we have experiences as of even if we are under a persistent illusion. Also, it is important to note that any respectable non-reductivist will hold that discovering what the colors are requires arduous philosophical investigation. All that is meant is that according to the non-reductivist the answer to “What are the colors?” has been hiding in plain sight.

My taxonomy implies that there can be no non-reductive, dispositional views on color. Watkins’ (2002) says that he holds a “non-reductive,” dispositional view. What Watkins means by this is that the colors are dispositions that are neither reducible to their realizers nor to relational properties (p. 137). However, as one can see from what I wrote above, my definition of “non-reductive” is entirely different from this. My argument against there being non-reductive, dispositional views is based on the premise that we do not experience what dispositions are. It goes like this. Given how I defined “reductive” and “non-reductive” as well as the domain of enquiry, it follows that non-reductive views on color hold that we experience what the colors are in our visual experiences as of colored objects. A property P is dispositional =df for some manifestation M and circumstances C, P is identical with the disposition to M in C. So, if there could be non-reductive dispositional views on what the colors are, we would have to experience the

relevant M and C's for the dispositions said to be identical with the colors in our visual experiences as of colored objects. I see no way around this. I think that it is somewhat plausible, at least *prima facie*, that we experience the relevant M's. For example, the relevant M for the property red could be said to be *that* (pointing to the redness of an object).

However, we do not experience any circumstances C in our visual experiences as of objects being colored. For my argument, one need merely reflect on one's experiences as of the colors so as to establish whether in these experiences any circumstances are experienced. I cannot recall ever being phenomenally presented with a circumstance(s) during an experience as of an object being colored. I only experience an object as being like *that* (pointing to a red object) or like *that* (pointing to a green one), and so on. In fact, I cannot even conceive of being phenomenally presented with a circumstance during an experience as of an object being colored. Of course, I can conceive of having an experience as of an object being colored and of a circumstance(s). Perhaps the object is also fragile, and I am experiencing it dropping. However, this would not be an experience as of an object being colored but of it being colored and dropping. Hence, this is irrelevant to my argument.¹⁶ Thus, it should be clear that dispositions cannot satisfy what is required of a non-reductive view. If I am correct, then no one, including Watkins, can be a non-reductive, dispositionalist about color (in my sense).

¹⁶ My argument is neither an argument that we cannot see dispositions (McGinn, 1996, p. 540) nor an argument to the effect that colors do not look like dispositions (Boghossian and Velleman, 1989, p. 86; 1991). It is only an argument that we do not experience any circumstances in our visual experiences as of colored objects, and so if colors are dispositional properties, we do not experience what they are in our visual experiences as of colored objects. Thus, there can be no non-reductive dispositional views given how I understand "reductive" etc. This would only imply that the colors are not dispositional properties if one assumes that we experience what the colors are in our visual experiences as of colored things. Johnston (1992) thinks that something like this is a core belief about the colors. If he is right, there is reason to be worried about all reductive views.

Reflectance dispositionalism is the same view called “reflectance physicalism” in Brogaard’s taxonomy. The view that colors are types (or sets) of reflectance dispositions that Byrne and Hilbert eventually retreat to is best categorized alongside micro-structuralism. We should also put in the category in which micro-structuralism is placed the view that the colors are disjunctions of micro-structural properties. I define appearance dispositionalism broadly as the view that the colors are dispositions to appear certain ways if certain generally specified stimulus conditions are met. Appearance dispositionalism divides into internal and external variants. Internal dispositionalism encompasses what is called “contemporary dispositionalism” in Brogaard’s taxonomy and “dispositionalism” in Cohen’s. Internal dispositionalism is the view that the appearances that the relevant dispositions are disposed to give are *internal* to us. Cohen’s role functionalism is a kind of internal dispositionalism. External dispositionalism holds that the appearances are *external* to us. Noë’s ecological dispositionalism is a kind of external dispositionalism, because Noë endorses what he calls “phenomenological objectivism” (2004, p.141-144) under which the appearances are in external objects. It is unclear whether Thompson’s (1995, p. 242-250) theory is an internal or external variant of appearance dispositionalism. If one accepts Byrne and Hilbert’s claim that the view is equivalent to contemporary dispositionalism, Thompson’s view is a kind of internal dispositionalism. Regardless, my taxonomy makes room for the view wherever it may fall.¹⁷

¹⁷ There are some dispositional views on color that are not mentioned by Brogaard and Cohen. Gert (2013) says, “x has color R iff subjects of kind S would have responses to x that can be summarized as a function $F_R(c)$. The domain of $F_R(c)$ is the set of possible viewing circumstances and the range of $F_R(c)$ is the set of possible apparent colors” (p. 187). This looks like an internal dispositionalism of sorts. According to Gert, it is a multiple aspect version of simpler response-dependent accounts. For Gert, because the (objective) color is associated with the function $F_R(c)$, only the apparent colors are strictly speaking located in the familiar

I have split Cohen's view into two versions that are close to the surface in his (2004; 2009) work. I said in section 1 that Cohen's view is one according to which it is constitutive of (or essential to) any color L that there is a relation R such that for any object x , x is color L iff there exists an observer y (which need not be the same for different x 's) such that x bears R to y (2004; 2009, p. 8-12, 24-36). Cohen's view 1 requires condition 1 below for when x bears R to y , and Cohen's view 2 requires condition 2.

1. R holds of $\langle x, y \rangle$ iff y is a viewing subject who is having a perception as of x being L.
2. R holds of $\langle x, y \rangle$ iff if a viewing subject y were to view x , then he would have a perception as of x being L. (For both options the viewing subject could be constrained so he must be normal or constrained in some other way. Cohen would be very loose with his constraints on the viewing subject.)

A case could perhaps be made for Cohen's view 2 being a dispositional view on color, because it gives the colors a connection with counterfactuals. However, as I said, a

color solid (what he calls 'HSB' space) (p. 187, 192). Recall that my identifying condition for this essay is that colors are the properties that we actually experience things as having when having visual experiences as of things being colored,' where 'an experience as of a thing being colored' is just an experience with *that* phenomenal character with which we are all familiar. At least some of the properties picked out by this identifying condition are located in the familiar color solid. For example, scarlet has a location in the familiar color solid. So, Gert's view on color is ruled out by my identifying condition in part 1.1. If one makes a distinction between the colors and the apparent colors in Gert's sense, then the colors are the apparent colors. (Broackes's view according to Gert is similar to his, but it is not sufficiently clear for me to be sure about this. If Gert is right, Broackes view may also be in trouble.)

Egan (2010) proposes that attributing the property being green to an object delivers the centered worlds proposition that is true at a world (w), time (t), and individual (i) iff the object is disposed to look green to i in the circumstances i occupies at t in w . This sounds like a relativist, internal dispositionalist view. If so, it could be placed in my taxonomy as a type of internal dispositionalism. However, as Egan states the view as one about when 'being green' is true using an 'iff', it is difficult to be sure exactly of what he is saying the colors are. I will not in this essay distinguish between relativist and non-relativist forms of dispositionalism. If Egan's view is indeed a form of internal dispositionalism, then I believe that what I say in this essay should be relevant to it. Also, what I say about Cohen's view (part 3.2) should also be relevant, because Egan's view has similar motivations.

property P is dispositional =df for some manifestation M and circumstances C, P is identical with the disposition to M in C. So, if Cohen's view 2 were a true dispositional view, one would think it would be expressible using the locution 'the disposition to M in C'. It is hard to imagine this being done effectively. So, I prefer to classify Cohen's view 2 as non-dispositional. If this is right, the view cannot give the colors the *special* connection to counterfactuals that a dispositional view would. It is also important to note that Cohen's view 1 and 2 have unintuitive consequences that quintessential dispositional views like appearance dispositionalism do not. Namely, both versions imply that objects would lose their colors if no observers existed. This is because x cannot bear R to an observer y if there are no observers. Cohen's view 1 also has the consequence that an object is not colored unless an observer y is perceiving it.

Cohen (2009, p. 10, footnote 16) says that his view is reductive. I have done as he says and taxonomized his view accordingly.¹⁸ However, as I have said, there is no obvious reason why there cannot be non-reductive relational properties. One may argue that the colors do not phenomenally look like relational properties (McGinn 1996, p. 541; Tye, 2000, p. 152). If sound, such arguments would pose a special problem for there being non-reductive, relational views on color. If primitivism is true, the colors had better phenomenally look like the properties we are accustomed to in the phenomenological domain of visual color experience. Nevertheless, it is unobvious whether the cited arguments work (Byrne and Hilbert, 2001). So, what I call "relational primitivism" is an important but unrecognized view worthy of serious consideration. Such a view would allow one to accept something like 'Revelation' that the natures of the colors are fully

¹⁸ There is a circularity in Cohen's view that is worrying to his opponents (Tye, 2012). Because of this circularity, one may reasonably doubt whether his view succeeds in giving a reduction of the colors.

revealed to us in perception (Johnston, 1992), while also allowing one to avoid Cohen's (2004; 2009) worry about ad hoc stipulation in variation cases.¹⁹ Different versions of this view depend on the relation involved, its relata, and when it holds of its relata. For primitivists who find relationalism hard to stomach, there is also non-relational primitivism.²⁰ All primitivist views must be species of either relational or non-relational primitivism.

Where do realism/irrealism, physicalism, categorical ground theories, Brogaard's role and realizer functionalism, Cohen's identity theory, and sensory classificationism fit in my taxonomy? Realism/irrealism are compatible with most of the views in my taxonomy. Cohen's view and contemporary dispositionalism are *prima facie* exceptions. As I mentioned, I agree with Cohen that the notion 'physical' should be avoided, as it is unclear what condition a property has to satisfy to be physical. Categorical ground theories are compatible with all of the non-dispositional theories in my taxonomy. Brogaard's role functionalism is compatible with any view that takes the colors to be second-level properties like appearance dispositionalism, and her realizer functionalism is compatible with all the views that take the colors to be first-level properties like micro-structuralism. My reductive characteristic subsumes Cohen's identity theory node by encompassing reductive views. Because of issues of interpretation, I leave it open as to where exactly Matthen's sensory classificationism belongs.

¹⁹ With this being said, I ultimately do not think that a primitivist version of Cohen's view is a good idea. In part 3.2 section 2, I argue that Cohen's concerns about ad hoc stipulation do not constitute a convincing argument. Moreover, part 3.2 section 4 speaks against the colors being constituted by relations to subjects (see also Roberts, Andow, and Schmidtke, 2014). Of course, none of this alone rules out all forms of relational primitivism.

²⁰ It is worth mentioning that there has been an attempt to develop a relativist, non-relational primitivism in order to better account for worries about ad hoc stipulation (Brogaard, 2010b). According to this view objects can only have non-relational primitive color properties relative to a viewer in a normal condition. What I say in part 3.2 against Cohen's relational view should be relevant to Brogaard's view, because they have similar motivations.

Conclusion

Without an adequate taxonomy the ontology of color is going to be much more difficult and prone to confusion than it would be otherwise. So, in this article, I first distilled two of the newest taxonomies and explained why they are unacceptable. Namely, I looked at Brogaard's taxonomy (section 1) and then Cohen's (section 2). I then provided a comprehensive argument against classifying dispositions as relational properties (section 3). Having learned from the vices and virtues of Brogaard and Cohen's taxonomies, I provided a much-improved way of taxonomizing views on color (section 4). My taxonomy rules out certain views, clarifies others, and shows that there is an unnoticed view worthy of serious consideration.

Part 2: Dispositional views

In this part, I investigate dispositional views on color. All known dispositional views on color are reductive and non-relational. In part 2.1, I argue against appearance dispositionalism; in part 2.2, I argue against reflectance dispositionalism; and in part 2.3, I provide a general argument against the colors being dispositions.

Part 2.1: Against Appearance Dispositionalism

In this chapter, I examine appearance dispositionalism. This is the view that for any color C , C is the disposition to appear some way if certain stimulus conditions are met (Bennett, 1971, p. 89-123; Dummett, 1979; McGinn, 1983; Peacocke, 1984; McDowell, 1985; Johnston, 1992; Wiggins, 1998, p. 189; Levin, 2000; Noë, 2004, p. 123-161). This view splits into internal dispositionalism and external dispositionalism.²¹ Internal dispositionalism holds that the appearances that the relevant dispositions are disposed to give are something in us, and external dispositionalism holds that the appearances are something external to us. Both views can be further divided into circular and non-circular variants. Thus, appearance dispositionalism is divisible into four different views: internal-circular dispositionalism, internal-non-circular dispositionalism, external-circular dispositionalism, and external-non-circular dispositionalism. I look at the motivation for internal variants of dispositionalism (section 1) and then the motivation for external variants (section 2). After doing this, I discuss the argument from circularity against circular variants of appearance dispositionalism (section 3). Roughly, this argument is that the circularity inherent to circular dispositionalism is problematic. Finally, I inspect non-circular variants (section 4). Roughly, I argue that these views all fail to adequately eliminate circularity.

²¹ Two things are important to note. First, internal versions of appearance dispositionalism attempt to give some refinement of the stimulus conditions. Often internal variants define the stimulus conditions to say 'if viewed by a normal observer in normal conditions.' There is a lot of discussion in the literature about how to understand both 'normal observer' and 'normal conditions' (Tye, 2006; Allen, 2010), but I am going to avoid this debate here.

Second, there is technically, logical room for versions of internal dispositionalism that do not state the stimulus conditions in terms of being viewed by a perceiver. However, as these logically possible versions are extremely implausible even absurd and are not defended by *anyone*, I for reasons of simplicity collapse internal dispositionalism with contemporary dispositionalism in this chapter and elsewhere.

Section 1: The motivation for internal variants

In this section, I look at some arguments in favor of internal dispositionalism. Internal dispositionalism is an old view on color, and so I will not try to be comprehensive. I avoid arguments based on outdated theories of perception like the sense data theory. See Byrne and Hilbert (2011) for a response to some arguments based on such views. I also avoid looking at Locke's arguments. These arguments are old hat for anyone who has done a philosophy degree and suffice to say not particularly clear or convincing. My plan is as follows: First, I look at a possible historical origin of internal dispositionalism and show that it cannot be used as a motivation. I then examine two early modern motivations, the first being based on the idea that we cannot conceive of the colors independent of how they phenomenally look and the second being based on the idea that internal dispositionalism resolves an incompatibility with physics. Finally, I look at Johnston's (1992) attempt to motivate internal dispositionalism.

1. 1: A possible origin of internal dispositional views.

Internal dispositional theories on color can be traced to an argument developed by Galileo (1623). He thought that we cannot conceive of a material substance without also imagining it as having a certain shape and size, as being located in space and time, as moving or not, as being in contact or not with other bodies, and as having a number. Thus, Galileo thought that the world really is the way it appears with respect to these properties. However, he went on to argue that we can conceive of a material substance without also conceiving of it as having a taste, making an odor, or having a color. Thus, he thought "[t]astes, odors, colors, etc so far as their objective existence is concerned, are

nothing but mere names for something which resides exclusively in our sensitive body, so that if the perceiving creature were removed all those qualities would be annihilated and abolished from existence” (Galileo, 1623, p. 28).

Galileo’s argument that tastes, odors, and colors are mind-dependent had a powerful impact on subsequent generations. It appears that we can conceive of a world full of tasteless, odorless, and colorless objects, but we cannot imagine a world full of shapeless objects. This distinction in what can be conceived influenced modern era philosophers like Descartes and Locke to believe that having a taste, having an odor, and being colored are dispositional properties (or something a lot like them called ‘secondary qualities’) (Hacker, 1991, p. 1-12). The reasoning may have gone like this. The explanation for why we experience objects as having tastes, smells, and colors even though they do not really have these properties is that the geometrical and numerical qualities of objects somehow cause us to have these experiences. Hence, an object’s appearing red, for instance, is really just an effect of that object’s having certain geometrical and numerical properties. So, if redness is anything at all, it is merely a dispositional property of objects to causes us to have certain experiences.

The first well-known, modern philosopher to endorse a dispositional view on color was probably Descartes. In *The Principles of Philosophy*, Descartes says, “[colors are] simply various dispositions in those objects that enable them to trigger various kinds of motions in our nerves that are required to produce all the sensations in our soul” (2008, 4-198). John Locke later alludes to an internal dispositional theory by saying, “[colors] nothing but *powers to produce various sensations in us by their primary qualities*, i.e. by the size, shape, texture, and motion of their imperceptible parts” (2004, ii-viii-10). Reid

(2005, 6-3, 4), among others, also endorsed an internal dispositional theory. These views are still popular today but increasingly less so. (It is worth noting that the reasoning outlined above could plausibly be used in an attempt to motivate other dispositional views besides internal dispositionalism. In fact, it is not clear from the Descartes quote that he accepted internal dispositionalism. My below arguments can be applied to attempts to use the above to motivate other versions of dispositionalism.)

1. 1. 1: Can this history motivate internal dispositional views?

In this section, I shall argue that the historical origin of internal dispositional views as outlined above cannot be used to motivate such views. The central problem with using the historical origin to motivate internal dispositional views is that there is a serious problem with reasoning from Galileo's conclusion that the colors are mind-dependent to the colors being dispositional properties. The issue is that the reasoning is internally inconsistent. Galileo's argument that the colors are mind-dependent properties may have lead to the view that they are dispositional, but dispositional properties are not mind-dependent ones (in any relevant sense). This is true even when dealing with a disposition specified by mentioning things that are mind-dependent. The reason is that an object can be disposed to cause an experience as of red if a certain kind of human were to look at it (in certain conditions) regardless of whether any humans exist. Thus, dispositional properties are not mind-dependent, and so reasoning from Galileo's argument that the colors are mind-dependent to the view that colors are dispositions is inconsistent.

Even if the reasoning from Galileo's conclusion to the colors being dispositional properties were consistent, the historical origin for internal dispositionalist views would

still fail to provide a reason to accept them, because Galileo's argument fails to show that the colors are mind-dependent. Galileo thinks that the mind-dependence of tastes, odors, and colors follows from our ability to conceive of a material substance without also conceiving of it as having any of these properties; however, this is a non sequitur. I can conceive of my computer not having a keyboard, but the existence of its keyboard is obviously not mind-dependent. What Galileo's argument requires is the premise that we cannot conceive of an object instantiating tastes, smells, and colors independently of our minds. Unfortunately, we can conceive of object's instantiating these properties independently of us quite easily (Hacker, 1991). I can conceive of the sky retaining its color, the flowers their odor, and the fish its flavor, regardless of whether there is anyone around to see the sky, smell the flowers, or savor the fish.

1. 2: Two early modern motivations

In this section, I will look at two modern motivations for internal dispositionalism. The first motivation is based on a conceptual argument involving the idea that we cannot conceive of the colors independent of how they phenomenally look, and the second is based on the idea that internal dispositionalism resolves an incompatibility with physics.

Section 1. 2. 1: Conceptual argument

Contrary to what I said above, there is an Oxford tradition that our concepts of the colors are the concepts of mind-dependent properties. It is also a part of this tradition that these mind-dependent properties are internal dispositionalist. This is just confused, because, as I argued, dispositional properties are not mind-dependent or at least they are not mind-

dependent in the sense that their existence depends on minds. As I said, this is true even when dealing with a disposition specified by mentioning things that are mind-dependent (e.g. appearances). Regardless, the view in question has influenced many generations starting with John Cook Wilson (1926), then H.A Prichard (1909), then Gilbert Ryle (1949), William Kneale (1950), Michael Dummett (1979), Gareth Evans (1980), and finally John McDowell (1985).

The argument that the colors are mind-dependent, internal dispositional properties is based on the idea that we can conceive of an entity as being mind-independent only if we can insert it into a simple theory of perception. In order to do this we must be able to recognize the duality of our experiences. That is, we need to be able to distinguish between the thing in the world on the one hand and our experiences of it on the other (Evans, 1980, p. 277). Recognizing the duality of our experience requires that we be able to conceive of that which the experience is of as existing independent of our experiencing the thing in question. Cook Wilson explains that we need to be able to identify “positive content different [...] from [our experiences of some thing], and clearly distinguishable from it” (1926, p. 773). However, as the argument goes, we can only conceive of, for example, scarlet in terms of how this property phenomenally appears in perception and *mutatis mutandis* for the other colors. Thus, the colors are mind-dependent, internal dispositional properties. (For more on this argument see Allen, 2007.)

Dispositions are not mind-dependent properties, and so the argument in question cannot show that the colors are mind-dependent, internal dispositions. In order to see whether this is the only reason to reject the argument’s conclusion, let us take the

dispositional component out. Taking this component out of the argument, it can be presented as follows:

P1. A property P is mind-independent only if one can conceive of an object having P independent of any minds experiencing the object being P.

P2. One can conceive of the property being scarlet only in terms of how it phenomenally appears, and mutatis mutandis for all the other colors.

(3). The colors are mind-dependent properties. (from P1, P2)

Does this version of the argument work? The answer, I think, is that it fails, because it is invalid. The reason for this is that whether one can conceive of the property being scarlet only in terms of how it phenomenally appears is irrelevant to whether one can conceive of an object being scarlet independent of any minds experiencing the object being scarlet. Our conception of the colors can go no deeper than what is phenomenally presented to us in color experiences, but it nevertheless be the case that we can conceive of an object being scarlet independent of our experiencing it being scarlet. In fact, as Hacker (1991, p. 116) correctly points out, we can easily conceive of objects being scarlet independently of our experiencing them: One need just conceive of an object as having *that* property with no mind around to perceive it. Thus, one can see that the argument for the colors being mind-dependent, dispositional properties in question fails regardless of whether I am right that dispositions are mind-independent.

Section 1. 2. 2: The physics argument

Another reason that many probably find internal dispositional theories compelling is that they resolve an apparent incompatibility between theoretical physics and our experience. Colors are not amongst the micro-structural properties by which theoretical physics describes the world. For example, The Standard Model of Particle Physics, which is able to explain most observed data, does not mention colors (in the vernacular sense). However, our experience represents the world in a mosaic of color. Internal dispositional theories say that both pictures are correct. Theoretical physics is correct that colors are not amongst the micro-structural properties needed to describe the world, and our experience is correct that the world is multiply colored. Colors are certain dispositions of the micro-structural properties talked about in physics. Of course, this same argument can be used to motivate other dispositional theories, but I will just look at this version of the argument. If this version fails then the others do to.

This attempt to motivate internal dispositional views is utterly unconvincing. The problem with this motivation is that the appearance of an incompatibility between theoretical physics and our experience is an illusion that arises from a suppressed premise that the only non-dispositional properties of objects are those mentioned in theoretical physics, but this premise is dubious at best not to mention question begging. So, there is no reason to accept the suppressed premise. Of course, this is not to say that theoretical physics is wrong. It is just to say that to completely describe the world we must mention those categorical properties given to us in perception in addition to those discovered by theoretical physics.

1.3: Johnston's argument

A much more recent argument that I will discuss here is due to Johnston (1992).²²

Johnston seems to endorse the natural sign theory of perception. According to this view, color perception involves figuring out the colors of external objects from the mental effects they produce in us, the natural signs. So, given this view of perception, it is natural to take Johnston to favor a non-circular variant of internal dispositionalism, whereby the appearances that the colors are disposed to give are mental effects and not the colors. However, contrary to this, Johnston (1992) often writes in a way that suggests he supports a circular variant of internal dispositionalism. Because of this lack of specificity, for simplicity I interpret Johnston as defending internal dispositionalism in general. So, I shall consider Johnston's argument here.

Before I can explain Johnston's reasoning, I must present what he considers to be our core beliefs about the colors, as his argument is an abductive one to the effect that the internal variant best satisfies the relevant beliefs. The core beliefs are as follows (1992, p. 222-223):

- (1) *Paradigms*. Some of what we take to be paradigms of canary yellow things (i.e. some canaries) are canary yellow.

²² There are other recent arguments that have been given in favor of internal dispositionalism besides Johnston's. Wiggins has argued for internal dispositionalism by saying, "Surely it is simply obvious that colour is something subjective" (1987, p. 189). This attempt to motivate the view is hard to take seriously. McGinn thinks that it is a logical or conceptual truth that x is red iff x (standardly) seems red (1983, p. 6, note 2). He has said that "[i]t is a conceptual truth that red things *typically* look red" (p. 11). I can *easily* conceive of a world in which red things do not typically look red. In fact, I can even *conceive* of the red things in the actual world not being those things that typically look red. So, I have no idea what McGinn is talking about. Boghossian and Velleman (1989, p. 84) and Byrne and Hilbert (2011) have more to say against claims like McGinn's.

- (2) *Explanation*. The fact of a surface or volume or radiant source being canary yellow sometimes causally explains our visual experience as of canary yellow things.
- (3) *Unity*. Thanks to its nature and the nature of the other determinate shades, canary yellow, like the other shades, has its own unique place in the network of similarity, difference and exclusion relations exhibited by the whole family of shades. (Think of the relations exemplified along the axes of hue, saturation and brightness in the so-called color solid. The color solid captures central facts about the colors, e.g. that canary yellow is not as similar to shades of blue as they are similar among themselves, i.e. that canary yellow is not a shade of blue.)
- (4) *Perceptual availability*. Justified belief about the canary yellowness of external things is available simply on the basis of visual perception. That is, if external things are canary yellow we are justified in believing that just on the basis of visual perception and the beliefs which inform it. (Further philosophical explication of this belief would come to something like this: If you are looking at a material object under what you take to be adequate conditions for perceiving its color and you take yourself to be an adequate perceiver of color then your visually acquired belief that the material object is canary yellow is justified simply on the strength of (i) the information available in the relevant visual experience and (ii) those general background beliefs about the external causes of visual experiences which inform ordinary perception.)
- (5) *Revelation*. The intrinsic nature of canary yellow is fully revealed by a standard visual experience as of a canary yellow thing.

With these core beliefs in mind, Johnston believes that two views stand out as *prima facie*, plausible options: The view that the colors are categorical, physical properties that causally explain our experiences as of color (what he calls “The Primary Quality View”), and the view that the colors are (constituted) dispositions to cause certain experiences in us if viewed (what he calls “The Secondary Quality view”). He admits that both views have a difficult time accounting for all the core beliefs but argues that the internal variant of appearance dispositionalism (The Secondary Quality View) ultimately does a better job of satisfying them. So, Johnston concludes that we ought to accept the internal variant of appearance dispositionalism, because this view but not The Primary Quality View best captures our core beliefs about the colors. More or less inclusively speaking internal appearance dispositionalism is the right view.

1.3.1: Why Johnston’s argument fails

There is a serious problem with Johnston’s (1992) above reasoning. The issue with it is that whenever he thinks of examples of categorical, physical properties he thinks of those kinds of properties discussed in modern physics. It does not take a genius to see that there are going to be issues with such properties fulfilling all of Johnston’s core beliefs, and I think that Johnston argues correctly that they do not. However, if Johnston had only loosened the condition he thinks a property must satisfy to be physical, he would have noticed that there are categorical, primitive properties available that are at least equally good if not better candidates for satisfying Johnston’s core beliefs, namely those primitive properties we experience objects as having when having visual experiences as

of colored objects.²³ In part 3.3 of this essay, I shall argue that primitivism is the best theory on color, because it best accommodates our core beliefs.

Section 2: The motivation for external variants

Internal variants of appearance dispositionalism are well-known in the ontology of color, and so it was easy to present Johnston's motivation for these views directly without first explaining them in depth. However, external variants of appearance dispositionalism are not known so well. So, in this section, I shall first in 2.1 present a version of the external variant with which to work, and then in 2.2 I shall discuss the motivation for this variant.

2.1: A variant of external appearance dispositionalism

A well-developed and often cited external variant of appearance dispositionalism is based on the ecological approach to zoology. This approach to zoology insists that the animal cannot be studied independently of its environment. James Gibson (1979), Prindle *et al* (1980), Turvey (1981), Evan Thompson (1995), and Alva Noë (2004) are supporters of the ecological method in zoology. The relevant external variant is the result of an attempt by Noë (2004) to carry the teachings of this method in zoology to the metaphysics of color.²⁴ On first pass, Noë's external variant seems to be that the color of an object is its disposition to modify its appearance with respect to color as relevant conditions change (2004, p. 144).

²³ Interestingly Johnston has now forsaken dispositional views on color (1997, 1998).

²⁴ Thompson (1995) and Noë (2004) have both discussed ecological theories of color. Noë's (2004) view seems to be an external dispositional theory. However, upon analysis, I think that Thompson's view is identical with internal dispositionalism. Byrne and Hilbert (2003a) agree by saying that Thompson's view does not seem to be any different from internal dispositional views (or as they say "traditional dispositionalism"). So, I will not provide a separate discussion of Thompson's view.

However, an important clarification is in order. Noë distinguishes between what for him are two numerically distinct properties: The colors objects appear to instantiate (the apparent colors) and the colors they “really” instantiate (the real colors). The real colors of objects are those that we normally associate with them. I shall refer to Noë’s real colors as “the colors,” for this seems to be what they are. The apparent colors for Noë are non-mental properties of external objects that we perceive in cases of color illusion (and perhaps also in cases of veridical perception).^{25, 26} I suspect my reader will find this notion obscure. One may worry that the apparent colors are mysterious. Either the apparent colors are phenomenally like the colors or they are not. If they are not phenomenally like the colors, they are not properties that are phenomenally presented in our color experiences. So what are they? It is utterly mysterious. If they are phenomenally like the colors, an experience as of something being apparent red, for instance, is identical with an experience as of something being red, but redness is the only property we experience things as having when having experiences as of red. So, as the apparent colors are supposed to be distinct from the colors, the apparent colors cannot be phenomenally like the colors. Thus, either way the apparent colors are mysterious properties to say the least. Regardless, using whatever understanding one has been able to gain, my first pass at understanding Noë’s external variant can be improved to say that

²⁵ Noë says, “An object with a determinate color *acts on*, or *responds to*, its environment in a certain way. For instance, it grows darker in a characteristic way in shadow, and it becomes brownish in green light [...]. [...] To be a particular red is to bring about these sorts of apparent changes in how things look” (2004, p. 143). Then on p. 144 Noë says, “Colors, like all appearances, are genuine features of the environment” (2004, p. 144). Noë also says, “you are able to experience [an object’s] merely apparent color [...]” (2004, p. 143).

²⁶ Allen (2009) interprets Noë as having a view in which the apparent colors are mind-independent in the sense that that things would have them regardless of whether there are any minds. One reason to think Allen is wrong is that the apparent colors change dependent on color relevant conditions, and color relevant conditions include dependencies between sensory stimulation and bodily movement (see below). I will not here take a side on whether the apparent colors are mind-independent in the relevant sense or not.

the view is that the (real) color of an object is its disposition to modify *its* apparent color as color relevant conditions change.

For any color, the color relevant condition is that color's sensorimotor profile (2004, p. 132). Sensorimotor profiles are constituted by movement-dependent contingencies and object-dependent ones (2004, p. 129-132). Movement-dependent sensorimotor contingencies are dependencies between sensory stimulation and bodily movement. Noë provides us with some examples (2004, p. 129): First, as a subject rotates a shape, differing amounts of light will reflect off its surface. The human retina is sensitive to the magnitude of incoming light. So, as one looks at a rotating shape, the "data" being sent to one's brain changes. Second, as one moves one's eyes, incoming light stimulates parafoveal receptors rather than foveal ones. Parafoveal receptors include more rods than cones, while foveal receptors are primarily composed of cones. Rods unlike cones are not sensitive to wavelength. Hence, as one moves one's eyes, the wavelength "data" sent to one's brain are continuously modified. Third, the fovea of the eye has a yellow pigment. The yellow pigment absorbs greater amounts of short wavelength light than long. So, different sensory effects result from eye movements across blue, green, and red objects.

Object-dependent sensorimotor dependencies are dependencies between object movement and sensory stimulation. Noë says that these dependencies are determined by regularities between a colored object, ambient light, the colors of other surrounding objects, and so on. For example, the sensory effects caused by an object change as it moves with respect to ambient light. Objects that are lit by green ambient light influence the retina differently than objects lit by red ambient light (2004, p. 130-131). Color

contrast effects constitute other examples (2004, p. 126). For instance, a television produces black images by failing to emit light in certain regions. When an old-fashioned TV is turned off its screen looks greenish gray not black. So, how does the TV produce black images? It is a contrast effect generated between the non-light emitting part of the screen and those nearby parts that are emitting light.

With these ideas in mind, Noë's view can be further refined to say that the color of an object is the disposition to change its apparent color (a property of the object) in accordance with the appropriate dependencies between sensory stimulation and bodily movement, and with the appropriate dependencies between object movement and sensory stimulation. As far as I can tell, the appropriate dependencies seem to be whichever ones are associated with the definiendum. For example, the property red is identical with the disposition to change apparent color in accordance with the dependencies between sensory stimulation and bodily movement, and with the dependences between object movement and sensory stimulation characteristic of red objects. Thus, I believe that Noë's view can be articulated as follows:

Ecological Dispositionalism: For any color C, that color C is identical with the disposition to modify an object's apparent color (in Noë's sense) in accordance with the C sensorimotor profile (which captures the appropriate dependencies between sensory stimulation and bodily movement and the appropriate dependencies between object movement and sensory stimulation for the color C)

2.2: The motivation for ecological dispositionalism

Noë suggests that ecological dispositionalism is motivated by his ideas on color experience (2004, p. 141). I believe that Noë's ideas can be divided into two theses. The first is Noë's thesis that our ability to perceive the colors is partly composed by sensorimotor knowledge. This thesis stems from a belief that Noë has about perceptual ability in general (2004, p.12, 27).²⁷ Sensorimotor knowledge is, for instance, knowledge that a sound appears louder the closer one is to its source, or knowledge that an object appears bigger as one moves towards it. With respect to color perception, the relevant sensorimotor knowledge is an implicit understanding of the ways objects' apparent colors change with respect to color-critical conditions (2004, p. 129). The way an object's apparent color changes with respect to color-critical conditions is given by its sensorimotor profile. Therefore, the relevant sensorimotor knowledge in the case of color perception is knowledge of objects' sensorimotor profiles.

The second thesis is about what it is for an object to look red. Noë distinguishes between looking colored here and now (apparent color) and looking colored (real color) (2004, p.139). Noë's idea seems to be that for an object to look apparent red is for it to look in such a way as to enable one to distinguish it from blue things in some ways, from scarlet things in others, and so on for all the colors (2004, p. 140). In contrast, for an object to look red is for it to look in such a way as to vary in apparent color in accordance with the red color profile (2004, p 140, 144). It seems that color profiles and sensorimotor

²⁷ Noë believes that this first idea has at least two important consequences. The first is that only life forms with the appropriate knowledge can be perceivers. With humanoid life forms, for example, "[...] a basic familiarity with the sensory effects of eye or hand movements and so forth [...]" is required (2004, p. 2). The second is that perception is not a process by which the brain forms internal representations of the world (2004, p.2). Noë does not mean to imply that perception does not depend on brain processes. Rather, what Noë means is that perception is more than merely a process in the brain; it is a "[...] kind of skillful activity on the part of the animal as a whole" (2004, p. 2).

profiles are the same thing for Noë (2004, p. 132). So, we can say that for an object to look red is for it to look in such a way as to vary in apparent color in accordance with the red sensorimotor profile.

Having distilled the above two theses, it is unclear how either can motivate Noë's metaphysics. Noë's idea that sensorimotor knowledge partly composes our ability to perceive the colors is logically unrelated to what the colors are. To think otherwise is to confuse epistemology with metaphysics. Thus, there is no obvious reason to think that Noë's first thesis can be used to motivate his view. What about Noë's second thesis that for an object to look red is for it to look in such a way as to vary in apparent color in accordance with the red sensorimotor profile? Again, this thesis is unrelated to the metaphysics of color. However, there is a *prima facie* plausible premise by which to move from how the colors appear to how they are (Hardin, 1988; Boghossian & Velleman, 1991). This premise is known as Infallibility (and is often considered part of Johnston's 1992 Revelation). Infallibility =df If after careful reflection (on our experiences as of the colors) it appears to be in the nature of the colors that *p*, then *p* is true (Byrne and Hilbert, 2007b). So, Infallibility can be used to get from Noë's second thesis to that red objects vary in apparent color in accordance with the red sensorimotor profile. The red sensorimotor profile is the way red things affect our senses (as we move and as they move in relation to other things) (2004, p. 129-132). Thus, it follows that red objects vary in apparent color in accordance with the way red things affect our senses. Call this, "Variation."

There are two readings of Variation. The first reading is that Variation says red objects cause viewers to have differing experiences according to how red objects affect

viewers' senses. This interpretation is not Noë's, but I shall consider it briefly. Variation under this interpretation is something that I believe any color theorist *should* accept. However, it is also a claim that any color theorist *can* accept, because there is nothing contentious about red objects causing differing experiences in observers according to how red objects influence viewers' senses. So, Variation under this interpretation is unable to motivate any kind of external dispositionalist view. The second reading is closer to what Noë would intend and is that red objects vary in their apparent color, in Noë's sense, according to how red things affect viewers' senses.

There are two interpretations of this second reading. The first is that the apparent colors and the colors are numerically the same. This is not Noë's view, but I shall nevertheless consider it briefly. Under this interpretation, Variation holds that objects vary in their color dependent on how their color affects our senses. If the colors of objects varied in accordance with how their colors affected our senses, would this imply that some kind of external dispositionalism is true? It may seem that the answer is 'maybe': Properties are either non-dispositional or dispositional, and if an object is square, it is so regardless of its effects on us. Upon closer examination, however, we can see that this answer is wrong. To see why, imagine a magic object that changes its shape dependent on how its shape affects us. The magic object could change its shape thousands of times a second, but whatever shape it is at a time, it would be that shape non-dispositionally. So, whether the colors of objects vary in accordance with how their colors affect us is irrelevant to whether some kind of external dispositionalism is true.

Of course, as I said, the first interpretation of the second reading is not Noë's. He believes that the colors and the apparent colors are numerically distinct properties. Hence,

the most textually accurate interpretation of Variation is that red objects vary in their apparent color in accordance with how their being red affects us. Unfortunately for Noë, it is unobvious how Variation under this interpretation, just like with its other interpretations, is supposed to motivate any kind of external dispositionalism. The reason is that there is nothing contentious about the interpretation other than its holding that the apparent colors are properties of external objects that we perceive (at least) in illusion cases, but whether this is true is unrelated to whether the colors are dispositional properties: One can just as easily hold that the colors are non-dispositional properties and that there are also Noë's apparent colors as one can hold that the colors are dispositional properties and that there are Noë's apparent colors. At the very least, I cannot see any reason why this is not true, so Noë need needs to say more.

As I have shown, it is utterly unclear how either of Noë's theses about perception is supposed to motivate his metaphysical view on color. So, why does Noë seem to think that they do? I am unsure of the answer to this question, but what follows is my attempt to give a clear argument for ecological dispositionalism using Noë's first thesis:

P1. Our ability to perceive the colors is partly composed by sensorimotor knowledge. The relevant sensorimotor knowledge is knowledge of sensorimotor dependencies between sensory stimulation and bodily movement, and between object movement and sensory stimulation. (Noë's first thesis)

P2. If a certain kind of knowledge partly composes our ability to perceive the colors, then it must look to be in the nature of the colors that this kind of knowledge partly composes our ability to perceive the colors.

P3. If after careful reflection on our experiences as of color a proposition p appears to be in the nature of the colors, then p is true. (Infallibility)

P4. The best explanation of it being in the nature of the colors that they are partly composed by dependences between bodily movement, object movement, and sensory stimulation is that they are dispositions in Noë's sense.

(5). It must look to be in the nature of the colors that they are partly composed by dependencies between bodily movement, object movement, and sensory stimulation. (P1-P2)

(6). It is in the nature of the colors that they are partly composed by dependences between bodily movement, object movement, and sensory stimulation. (P3, (5))

(7). Therefore, the colors are dispositions in Noë's sense. (P4, (6))

There are a lot of things about the above argument that are suspicious, and so because of this I do not think it could ever be a convincing argument. The most notable problem is step (5).²⁸ Unfortunately, this step does not follow from P1-P2. The reason is that it can look to be in the nature of the colors that sensorimotor knowledge partly composes our ability to perceive the colors without it looking to be in the nature of the colors that they are partly composed by sensorimotor dependences (i.e. dependencies between bodily movement, object movement, and sensory stimulation). It can look to be in the nature of x that the ability to perceive x is partly composed of $Q_1 \dots Q_n$ without it looking to be in the nature of x that it is partly composed by $Q_1 \dots Q_n$. Thus, the argument under consideration is invalid at step (5).

²⁸ I question Infallibility in part 3.3. By so doing I call P3 into question.

Section 3: Against the circular variant

The argument from circularity against the circular variant of appearance dispositionalism is that the circularity inherent to the view is problematic. The internal version of the circular variant is that for any color *C*, *C* is identical with the disposition to cause experiences as of *C* if viewed (McGinn, 1983; McDowell, 1985; Wiggins, 1998, p. 185-214) and the external version being considered (ecological dispositionalism) is the view that for any color *C*, *C* is identical with the disposition to change the apparent color of any object with the disposition in accordance with the *C* sensorimotor profile (Noë, 2004, p. 123-161). Why ought we to be worried about circularity? One may point out that the identity claim that the property red is identical with the property red is circular, but this does not seem to be an issue. Of course, one may say that if the circular variant were a semantic theory, there would be a genuine worry, because circular definitions are useless at explaining their definiendums to anyone who does not already have an understanding of their meanings. Circular dispositionalism, however, is not a semantic theory. So, I shall look at why the inherent circularity is detrimental to this view on color. For simplicity, I shall concentrate on the internal variant of circular dispositionalism when presenting the arguments, but most of what is said for this view can be said for Noë's circular, external variant (in addition to a circular, sensory classificationism under Cohen and Egan's interpretations). I shall look at the argument from vacuity in section 3.1 and then the argument I endorse in 3.2.

3. 1: Argument from vacuity

The first argument I will discuss for the circularity being problematic is that it would result in the content of our experiences as of the colors being vacuous. This argument is very close to the surface in Boghossian and Velleman (1989, p. 90). For example, they say, “the proposed circular definition would imply that the content of color experience is vacuous” (1991, p. 83).²⁹ The argument from vacuity runs as follows: (1) Assume that (internal) circular dispositionalism is true, and so that being red is identical with the disposition to cause experiences as of red if viewed. So, (2) an experience represents an object as red iff it represents it as having the disposition to cause experiences as of red if viewed. Hence, (3) an experience represents an object as red iff it represents it as having the disposition to cause experiences as of [the disposition to cause experiences as of red if viewed] if viewed and *mutatis mutandis ad infinitum*. Thus, (4) we cannot represent objects as being red. (5) We can represent objects as being red. Therefore, (6) circular dispositionalism must be false.

²⁹ Boghossian and Velleman (1989, p.90) are explicitly responding to the view that “*Red* [i.e., the property that objects are seen as having when they look red] =df a disposition to appear red under standard conditions” (1989, p. 84). Byrne and Hilbert (2011, p. 340) interpret this as a statement of property identity, and so following them I understand Boghossian and Velleman to be responding to the circular variant of dispositionalism. To avoid worries regarding whether this is the correct interpretation, I will stop short of pinning the argument from vacuity on Boghossian and Velleman, but it is important to realize that, at the very least, they endorse something similar.

Boghossian and Velleman’s original words are as follows: “[Given the definition of red above] an experience can represent its object as red only by representing it as disposed to provide visual experiences that represent it as red. The problem here is that the experiences that the object is thus represented as disposed to produce must themselves be represented as experiences that represent the object as red, rather than some other colour—lest the object be represented as disposed to appear something other than red. Yet these experiences can be represented as representing the object as red only if they are represented as representing it as disposed to produce experiences that represent it as red. And here the circle gets vicious. In order for an object to appear red rather than blue, it must appear disposed to appear red, rather than disposed to appear blue; and in order to appear disposed to appear red, rather than disposed to appear blue, it must appear disposed to appear disposed to appear red, rather than disposed to appear disposed to appear blue; and so on. Until this regress reaches an end, the object’s appearance will not amount to the appearance of one colour rather than another. Unfortunately, the regress never reaches an end.” (1989, p. 90)

There are two objections to this argument. The first objection is to say that the inferences from (1) to (3) are invalid. This objection must be taken seriously, because it is unclear whether it is valid to substitute identicals in representational contexts (Byrne and Hilbert, 2011, p. 342-346). In fact, it seems plausible that one cannot substitute identicals in representational contexts when using any relevant sense of 'represent' close to the vernacular. The second objection is to say that the inference to (4) is invalid. This objection must be taken seriously, because it is unclear why the circularity in circular dispositionalism would force our visual systems to run “an endless gamut of visual appearances” (Boghossian and Velleman, 1989, p. 89).

The above two objections constitute a serious predicament for the argument from vacuity. The issue is that to avoid the first objection, the argument's proponent must hold that identicals can be substituted in representational contexts, but then he cannot avoid the second objection. Let me explain. If the argument's proponent holds that identicals can be substituted in representational contexts, then he must say that the term 'represent' should be read transparently in the argument. Given this reading of the term, it is true that one can represent that an object is red iff one represents it as having the disposition to cause experiences as of [the disposition to cause experiences as of red if viewed] if viewed and *mutatis mutandis ad infinitum*, but this is something that one can easily do. All one has to do is transparently represent that the object has the disposition to cause experiences as of red if viewed, end of story. There would be no need to run an endless gamut of visual experiences (Byrne and Hilbert, 2011, p. 342-346).

Perhaps there is a way out for the proponent of the argument from vacuity. The argument may run as follows: We can represent an object's being red transparently only

if we can be directly acquainted with an object's being red. Only non-dispositional properties can give objects a structure with which to be directly acquainted. Call this, 'Direct-Acquaintance.' So, we can be directly acquainted with an object's having a property only if that property is non-dispositional. Circular dispositionalism holds that the colors are dispositional properties. Thus, the proponent of this view cannot say that the disposition to cause experiences as of red if viewed gives objects a structure. Therefore, assuming that circular dispositionalism is true, we can get that the inference to (4) in the argument from vacuity is indeed valid.

I am sympathetic with the premise Direct-Acquaintance. Unfortunately, as I suspected, the proponent of the vacuity argument cannot avoid my second objection without admitting that the inferences from (1) to (3) are invalid. Let me explain. If Direct-Acquaintance is true, then it does not make sense to read the term 'represents' transparently in the vacuity argument. Thus, in accepting Direct-Acquaintance one should admit that the inferences from (1) to (3) are invalid. Thus, although I am sympathetic with Direct-Acquaintance, a premise Boghossian and Velleman (1989, p. 90-91) may in fact implicitly appeal to, it should be clear that the premise cannot be used to defend the vacuity argument against circular dispositionalism.

3. 2. My reasoning about the circularity

Internal circular dispositionalism, in so far as it is an answer to the question "what are the colors?" as appropriately understood for this essay, must provide us with the identity conditions for the colors. Identity conditions, as I explained in part 1.1 of this essay, tell us what the entities are that are identical with the colors. Unfortunately, internal circular

dispositionalism either fails to provide an answer to the relevant question appropriately understood or provides a nonsensical one. Either internal circular dispositionalism tells us what the entities are which are identical with the colors or it does not. If it does not, then the view fails to answer the relevant question as understood in this essay: The relevant question as correctly understood, as I just said above, requires an answer that tells us what the entities are that are identical with the colors.

If internal circular dispositionalism does tell us what the entities are that are identical with the colors, then the view says that, for instance, the property of being red is identical with the thing, the disposition to cause experiences as of the property of being red if viewed. The relevant thing is composed of the property red and the disposition to cause experiences as of [*something*] if viewed. Thus, if internal circular dispositionalism tells us what the entity is that is identical with redness, it says that redness is identical with redness and the disposition to causes experiences as of [*something*] if viewed, and *mutatis mutandis* for the other colors. Unfortunately, as redness cannot be a proper part of itself, this kind of answer is an incoherent answer to the question “what are the colors?” Thus, one can see that internal circular dispositionalism either is not an answer at all to the relevant question or is an incoherent one.³⁰

The only premise that I can anticipate anyone questioning is the one that says, ‘the property of being red is a proper part of the thing, the disposition to cause experiences as of red if viewed.’ Although I can anticipate someone balking at this premise, I think that in the end it is sound and obviously so. The relevant entity, the disposition to cause experiences as of red if viewed, has the following structure: The

³⁰ Johnston (1998) also rejects circular dispositionalist views because they hold that being red is identical with something that has being red as a proper part. He agrees that this is incoherent.

disposition to M in C, where M is ‘cause an experience as of the property R’ and R is ‘redness.’ Thus, one can see that being red is a proper part of the thing, the disposition to cause experiences as of red if viewed. Of course, it is a logical proper part and not a spatial-temporal proper part, but this is irrelevant. In light of what I have said, circular dispositionalism must be rejected as an adequate view on color.

Section 4: Against the non-circular variant

In this section, I will first in 4.1 examine the internal version of non-circular dispositionalism, and next in 4.2 I shall examine the external version of non-circular dispositionalism.

4.1: The internal version of non-circular dispositionalism

According to internal, non-circular dispositionalism every color C is identical with the disposition to cause an experience as of P if viewed, where the entity picked out by P must be different from that picked out by C. There are two versions of this view. The first holds that P must pick out a non-mental entity of some sort. The second holds that P picks out something mental. This mental entity could be a sensational property or a mental object like sense-datum. Peacocke has devoted a lot of ink to developing a view that falls into the second category. Peacocke holds that an object is red iff it is disposed “[...] in normal circumstances to cause the region of the visual field in which it is presented to be red’ [a property of the visual field] in normal humans” (1983, p. 39; 1984, p. 60). Given this view, one must interpret the phrase ‘an experience as of P’ to say

something like ‘a P experience’ (and this applies below). I shall now look at two arguments against internal, non-circular dispositionalism.

4. 1.1: My first argument

My first argument against (internal) non-circular dispositionalism runs as follows: Non-circular dispositionalism says that, for instance, an object is red iff it is disposed to cause experiences as of some other property red* if viewed (where red* is either a mental entity or some sort of external color-like entity). Red* is either a non-dispositional property or another disposition to cause experiences as of something or another if viewed. If it is the former, then we must ask, “Why is red* a non-dispositional property but not being red?” No answer is readily available, and so we should reject this option. If it is the latter, then in order to avoid circularity the non-circular dispositionalist must say that the property red* is identical with a non-circular disposition. The only choice forthcoming is to say that red* is the disposition to cause experiences as of red** if viewed. Unfortunately, this option also fails, because it attempts to explain the property red* using a mysterious red** property. Thus, non-circular dispositionalism should be rejected as a poor theory about what the colors are.

I think that this argument shows that there is a serious issue with non-circular dispositionalism. Unfortunately, the argument has some weaknesses. The worst weakness is that the non-circular dispositionalist can reject the premise to the effect that the second option fails, because it tries to explain the property red* using a mysterious red** property. The proponent of non-circular dispositionalism can say that explanations must come to an end eventually, and that they come to an end with these color** properties. Of

course, I admit that this response on behalf of the non-circular dispositionalist is going to have limited appeal. The reason is that, even though explanations must come to an end eventually, it is unattractive that they should come to such an odd one. Regardless, there is a stronger argument than this one.

4.1.2: My second argument

My second argument against non-circular dispositionalism is roughly that the property red* must be identical with the property red, and so non-circular dispositionalism collapses into circular dispositionalism and succumbs to my previous objection regarding circularity. My argument runs as follows: The property red* (whether a mental entity or a non-mental property of external objects) is either phenomenally like the property red or some other property, call it “rad.” If the property red* is phenomenally like the property red, then to cause an experience as of red* is to cause an experience as of red. So, if red* is phenomenally like the property red, then non-circular dispositionalism collapses into circular dispositionalism. Unfortunately, as I showed in the previous section, circular dispositionalism cannot succeed, because the view implies, nonsensically, that the colors are identical with a property of which they are proper parts.

I believe that introspection shows that experience is transparent: The properties phenomenally presented in our experience are represented as properties of the external world (Harman, 1990, p. 667; Tye, 2000, p. 45-51, 2002; Speaks, 2009).³¹ So, if red* is

³¹ Harman’s well-known example of transparency is worth providing here: “When Eloise sees a tree before her, the colors she experiences are all experienced as features of the tree and its surroundings. None of them are experienced as intrinsic features of her experience. Nor does she experience any features of anything as intrinsic features of her experiences. And that is true of you too. There is nothing special about Eloise’s visual experience. When you see a tree, you do not experience any features as intrinsic features of your experience. Look at a tree and try to turn your attention to intrinsic features of your visual experience.

phenomenally like the property *rad*, then an experience as of an object being *red** represents (in the sense relevant here) that the object is *rad*. Ex hypothesi, red objects are disposed to cause experiences as of *red**. So, it follows that whenever we direct our gaze towards a red object (at least in typical conditions) we represent that the object is *rad*. Redness is roughly the property that we represent all red objects as having in common in typical circumstances. Hence, the property *rad* must be the same as the property *red*. Thus, an experience as of *red** must just be an experience as of *red*. Therefore, under both options, non-circular dispositionalism collapses into circular dispositionalism and so succumbs to my argument from circularity.

A likely retort is to reject my premise to the effect that if *red** is phenomenally like the property *rad*, then an experience as of an object being *red** (under either interpretation) represents (in the relevant sense) that the object is *rad*. I think that this premise has strong introspective support and so is not easily set aside. Nevertheless, if one does not believe that the premise is true, it is probably because one finds at least some anti-intentionalist, thought experiment based arguments convincing (Shoemaker, 1982; 1991, p. 511-513; Boghossian & Velleman 1989, p. 93-94). Anti-intentionalist arguments attempt to show (amongst other things) that two experiences E_1 and E_2 can differ in representational content but not in phenomenal character. Thus, if anti-intentionalist arguments are sound, an experience as of *red** *can* be phenomenally like an experience as of *rad* but not represent objects as being *rad*.

I believe that this response is anodyne. My argument against non-circular dispositionalism only requires that the properties phenomenally presented in experience

I predict you will find that the only features there to turn your attention to will be features of the presented tree” (1990, p. 667).

be represented as properties of the external world in *typical* conditions. However, anti-intentionalist arguments employ *atypical* scenarios to show (amongst other things) that it is not *necessarily* the case that if two experiences differ in representational content, then they differ in phenomenal character. Shoemaker's (1982, p. 362-362) no-inference argument, for example, requires a complicated thought experiment in which a man named 'Fred' goes through a series of color inversions relative to a color circle such that, after some time, it appears to Fred as if each color on the color circle has been replaced by its complement on the opposite side of the circle. Therefore, it is compatible with the success of anti-intentionalist arguments that it is *typically* the case that if two experiences differ in representational content, then they differ in phenomenal character. Thus, my second argument has nothing to worry about.

4.2: The external variant of non-circular dispositionalism

In order to avoid the argument from circularity against ecological dispositionalism, one may try to develop a non-circular variant of this view. Doing so would give us a non-circular variant of external dispositionalism. Here is one way of trying to develop such a variant. According to Noë, an object's color profile is composed of the appropriate dependencies between sensory stimulation and bodily movement (movement-dependent dependences), and with the appropriate dependencies between object movement and sensory stimulation (object dependent dependences) (2004, p. 129-132). However, there is no immediately obvious reason why these dependences cannot be defined non-circularly. For example, one may try to capture movement-dependent dependences non-circularly by using a three dimensional coordinate system. The position marked 0, 0, 0

could be used to represent the color. The coordinates x, y, z , other than $0, 0, 0$, could be used to represent one's position relative to the color. With these ideas in mind, it may be said that we can capture the color's effects on our senses as we move by writing them next to each coordinate x, y, z on the graph, other than $0, 0, 0$. This mess can be cultivated into a list L_C that says how the color affects our senses at each coordinate.

I do not believe that any attempt to capture the appropriate movement-dependent and object-dependent dependencies non-circularly can succeed. There are two *prima facie* plausible interpretations of 'our' in the phrase 'affects our senses as we move.' The first reading is that 'our' means 'the people on Earth around now.' The issue with the strategy under this interpretation is roughly that it is physically possible for people to evolve sensory apparatus' that are affected differently by red objects. My argument is as follows: Assume being red is identical with the disposition to modify apparent color in accordance with L_R restricted to people on Earth around now. Now, suppose that future people although they can see redness have senses that are affected in a wholly different way by this property. Given this supposition, it follows that being red would not vary in apparent color in accordance with its effects on these people's visual systems, but this *at the very best* is very strange. After all, why would the colors not vary in apparent colors for future people with different visual systems? So, we ought to reject that being red is identical with the disposition to change apparent color according to L_R restricted to people on Earth about now, and *mutatis mutandis* for the other colors.

The second reading of 'our' is that it means 'all metaphysically possible people.' The issue with this reading is roughly that it is metaphysically possible for there to exist infinitely many people whose visual systems red objects affect differently. My argument

runs as follows: Assume that being red is identical with the disposition to modify apparent color in accordance with L_R restricted to metaphysically possible people. There are infinitely many metaphysically possible people who can see redness but whose visual systems are affected differently by red objects. A person with electronic eyes, for instance, is a person nevertheless. Therefore, the red profile cannot be non-circularly captured by a list L_R that says how the color affects our senses at each coordinate under this interpretation, as the list could never be specified in full without mentioning redness. The same goes *mutatis mutandis* for the other colors.

My opponent could respond by saying that even though the red profile cannot be captured by a list L_R without mentioning redness, the property red is not a part of the list: For any color C , that color is identical with the disposition to change the apparent color of any object with the disposition in accordance with an infinitely long list L_C , *merely* picked out using C . I think this response is decent as far as it goes, but there is a serious deficiency with the aforementioned view on color. The deficiency is that one cannot get one's mind around an infinite list. So, the response leaves an important part of what the colors are unexplained: What *exactly* are the C lists? Although this is not a knock down argument, it is a reason for caution: Why accept a view that leaves such an important part of what it says the colors are unexplained, especially considering that the colors are familiar properties that we perceive external objects as having? Perhaps there is an answer to this question. However, one has not yet been provided. Recall that Noë's theses about perception fail to motivate his ecological dispositionalism.

Conclusion

In this chapter, I examined appearance dispositionalism. This view can be split into internal dispositionalism and external dispositionalism. Internal dispositionalism holds that the appearances that the relevant dispositions are disposed to give are something in us, and external dispositionalism holds that the appearances are something external to us. Both views can be further divided into circular and non-circular variants. Thus, appearance dispositionalism is divisible into four different views: internal-circular dispositionalism, internal-non-circular dispositionalism, external-circular dispositionalism, and external-non-circular dispositionalism. I looked at the motivation for internal variants of dispositionalism (section 1) and then the motivation for external variants (section 2). After doing this, I discussed the argument from circularity against circular variants of appearance dispositionalism (section 3). Then I inspected non-circular variants (section 4). Most generally, I have shown that appearance dispositionalism is a poor view on color and so should be rejected.

Part 2.2: Against Reflectance Dispositionalism

In this chapter, I shall examine reflectance dispositionalism. This is the view that the colors are identical with dispositions to reflect certain proportions of incident light at each wavelength of the visible spectrum (Byrne and Hilbert, 1997, 2003a; Tye, 2000). These dispositions can be called ‘surface spectral reflectance properties’ (or ‘reflectances’ for short). There are three things I want to do in this chapter. First, I will sharpen reflectance dispositionalism and look at its motivation (section 1). Second, I will argue that reflectance dispositionalism succumbs to the modal version of what I call the “objection from structure” (section 2). Roughly, the objection states that reflectance dispositionalism is unable to account for the resemblance relations that necessarily hold between the colors. Third, I will argue that reflectance dispositionalism succumbs to what I call the “objection from metamers” (section 3). The problem stems from the empirical truth that objects with distinct reflectances often appear to have the same color to normal observers under normal viewing conditions.

Section 1: Sharpening and motivating

1. 1: Sharpening reflectance dispositionalism

Reflectance dispositionalism says that the colors are identical with dispositions to reflect certain proportions of incident light at each wavelength of the visible spectrum. However, there is a vagueness here left open in the literature as to how we ought to qualify ‘incident light.’ The reason this vagueness is a concern is that the proportion of incident light reflected at each wavelength of the visible spectrum is dependent, among other things, on the wavelength proportions of the illuminate. The proportion of wavelengths

found in the illuminate is, for example, causally dependent on its source. The amount of red light (620-750nm) produced by a translucent red light bulb is disproportionate to that of the other wavelengths. So, the proportion of red light reflected by an object illuminated by a red light bulb will be different from the proportion emitted by that same object illuminated by an ordinary bulb.

The immediate solution to our problem is that the terms ‘incident light’ should be qualified to say ‘normal (incident) light in normal conditions.’ However, how we should understand this qualification is a contentious issue. Moreover, the situation gets complicated quite quickly. I take it that there are four ways to clarify ‘normal light,’ and four ways to clarify ‘normal conditions.’ This leaves us with sixteen plausible options total for understanding ‘normal light in normal conditions.’ Let us look at the four ways to understand ‘normal light’ and ‘normal conditions.’ The first is to say that ‘normal light’ and ‘normal conditions’ should be clarified to say ‘any physically possible visible light’ and ‘any physically possible conditions’ respectively. The second is that the terms should be clarified to say ‘roughly statistically average visible light’ and ‘roughly statistically average conditions’ respectively. The third is that the terms should be clarified to say ‘ideal light’ and ‘ideal conditions’ respectively, where ‘ideal x’ means x of a certain kind other than statistically average. The fourth strategy is that ‘normal light’ should be clarified to say ‘light that would be judged normal by a person who we ought to listen to concerning such matters,’ and similarly with ‘normal conditions.’

I believe that the proponents of reflectance dispositionalism must provide a story of normal light in normal conditions along one of the above options if their theory is to be complete. For the purposes of this chapter, we can think of ‘incident light’ as ‘normal

light in normal conditions,' without an exact understanding of the phrase in mind, because none of my arguments hinge on the qualification. I just wanted to note that 'incident light' must be qualified in some way. I do not want to investigate further how this should be done.

1. 2: The motivation

Byrne and Hilbert (B&H) believe that reflectance dispositionalism is motivated by the fact that it meets what they consider to be three conditions on any plausible physical theory of color (2003a, p. 8-9). These conditions are as follows: (1) The theory must reduce the colors to (or identify colors with) physical properties of objects; (2) the theory must reduce the colors to the right type of property to play a certain causal role in color perception; and (3) the theory must reduce the colors to a property that is reasonably illumination independent.

The first condition reflects the fact that the vernacular concept of color is the concept of a certain property of objects. Thus, the concern of a physical, philosophical theory of color is different from the theory of color in physics. This is because the concept of color employed by physicists is the concept of a certain property of light, while physical, philosophical theories of color endeavor, amongst other things, to explain what makes statements about red tomatoes true. Despite this difference, B&H believe that physical, philosophical theories of color ought to be primarily concerned with the properties represented by our experiences as of the colors.

The second condition that B&H believe any plausible physical, philosophical theory of color must satisfy ensures that such theories of color are relatively similar to the

theory of color used in physics. After all, physicists hold that any plausible theory must reduce “the colors” to the right type of property to play a certain causal role in their theories. The first condition, thus, ensures that physical, philosophical theories of color come out as distinct from theories of color set forth by physicists, and the second condition ensures that physical, philosophical theories of color are relatively similar to theories of color held by physicists.

The third condition exists, because it is common sense that the color that we see an object as having remains reasonably constant through changes in illumination. For example, if a red tomato is taken from one illumination condition (bright sunlight) to another condition (fluorescent lighting), we continue to see the tomato as being red. This phenomenon is known as ‘color constancy.’ A plausible physical, philosophical theory of color must, then, imply that the properties it takes to be the colors stay reasonably constant through changes in illumination, i.e. the properties must be to some reasonable extent illumination-independent.

1.2.1: The motivation’s deficiency

The above motivation is good as far as it goes but it has a serious deficiency that I will now explain. The deficiency is that just because reflectance dispositionalism meets the three conditions listed above does not imply that it is true. In order for the motivation to do this one would need the following premise: The only view that can meet the three conditions is reflectance dispositionalism. Unfortunately, not only has no argument been supplied for this premise but also it is difficult to see how such a premise could ever be plausibly argued for: The notion of ‘physical’ is unclear and problematic (part 1.2); there

are other properties of objects that can play a role in color perception (see part 3.1 and 3.3); and there are also obviously many properties of objects that are more or less illumination independent.

Section 2: The objection from structure

The modal objection from structure rests on two crucial premises. I will explicate the first and then the second. Call the first premise Unity. Unity is the claim that the colors necessarily stand in particular resemblance relations with respect to certain intrinsic properties. For example, blue is necessarily more similar to purple than to green with respect to these intrinsic properties.³² Why believe Unity? The answer usually given is that it appears to be obviously true upon reflection on experiences as of color (Westphal, 1987, p. 125; Hardin, 1988, p. 66; Boghossian and Velleman, 1991, p. 95; Pautz, 2006; Allen, 2009a, p. 205).³³ As I said in 1.1, my identifying condition for the colors is that they are the properties that we actually experience things as having when having visual experiences as of things being colored,' where 'an experience as of a thing being colored' is just an experience with *that* phenomenal character with which we are all familiar. These properties certainly appear as if Unity is true of them.

The second crucial premise is Not-Similar. This premise states that dispositions to reflect certain proportions of incident light do not necessarily have the appropriate resemblance relations with respect to certain intrinsic properties (and the same would go

³² Unity is sometimes combined with the claim that the colors necessarily have a certain binary/unitary character (Byrne and Hilbert, 2003a; Pautz, 2006). For example, necessarily purple is a perceptual mixture of red and blue while green is not a perceptual mixture of any other colors. I do not understand Unity in this way.

³³ This claim does not rely on Infallibility: The thesis that if a proposition *p* seems true of the colors, then it is true of the colors. Rather, the claim only relies on the much weaker premise that we know some truths about the colors based on how they appear.

for types, sets, and disjunctions of these dispositions to reflect light) (Hardin, 1988, p. 66; Pautz, 2006). For example, assume the reflectance dispositionalist identifies the reflectances R_b , R_p , and R_g with being blue, being purple, and being green respectively. Necessarily, being blue is more similar to being purple than to being green. However, Not-Similar claims that it is not the case that necessarily R_b is more similar to R_p than to R_g .

Why believe Not-Similar? The argument for Not-Similar is that upon examining the reflectance curves for R_b , R_p , and R_g we can see that there are no motivated means by which to hold that they stand in the appropriate similarity relations (and the same goes for types, sets, and disjunctions of reflectance dispositions). Take a look at the following graph (Byrne and Hilbert, 2003a, p. 13) as depicted in figure 2.1 below:

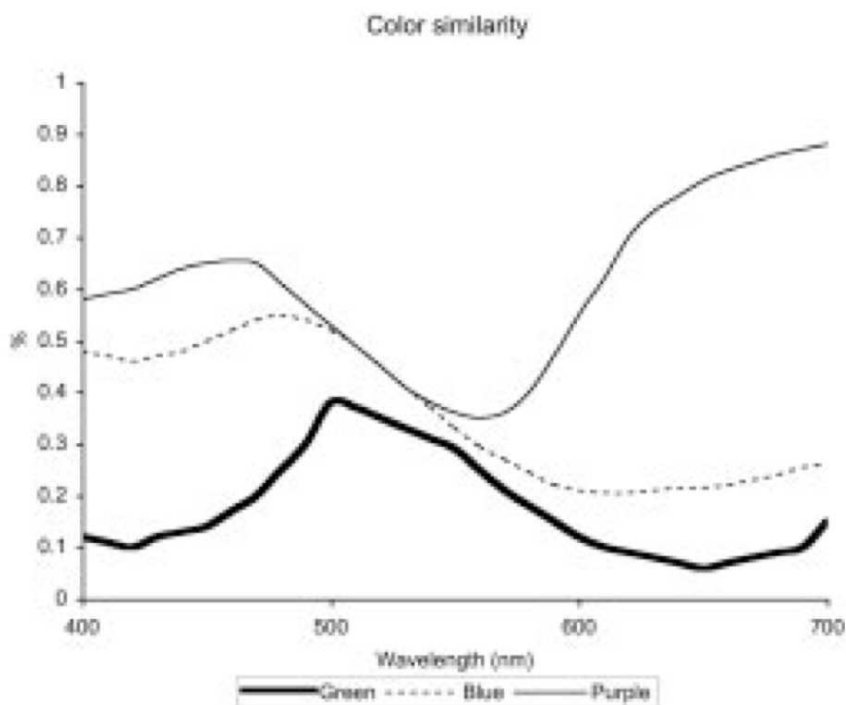


Figure 2.1. Color similarity. The x-axis represents wavelength in nanometers (nm), and the y-axis represents percentage of wavelength in nm.

It is unobvious how to justifiably hold that the dotted line (the typical reflectance curve of blue objects) resembles the solid regular line (the curve for purple objects) more than it does the bold one (the typical curve for green objects). Thus, it is reasonable to hold that Not-Similar is true.

With the two crucial premises stated, the argument from structure proceeds as follows (Hardin, 1988, p. 66; Maund, 1995, p. 126-133; Thompson, 1995, p. 124; Pautz, 2006):

- P1. Necessarily, blue is more similar to purple than to green. (Unity)
- P2. Necessarily, blue is identical with R_b , purple is identical with R_p , and green is identical with R_g . (Reflectance dispositionalism)³⁴
- P3. It is not the case that necessarily R_b is more similar to R_p than R_g . (Not-Similar)
- (4). Necessarily, R_b is more similar to R_p than R_g . (From P1, P2)
- (5). Therefore, reflectance dispositionalism is false. (From 4, P3)

There are three likely ways one might try to reject this modal argument. The first is to reject Not-Similar, the second is to reject Unity, and the third is to reject the move from Unity and reflectance dispositionalism to step four. I shall argue against these attempts in turn.

³⁴ Reflectance dispositionalism is necessarily true if true at all, because all identities are necessary identities.

2. 1: Reject Not-Similar

The first objection to Not-Similar is due to B&H (2003a, p. 15). The idea is complicated but can be simplified considerably for our purposes. First, I must briefly outline the opponent process theory. Roughly, opponent process theory states that the outputs of three cone-types (in the eye) are altered into two so-called “opponent” chromatic channels and one so-called “non-opponent” achromatic channel. The three cone-types are longwave cones (L), mediumwave cones (M), and shortwave cones (S). The channels created from the outputs of these cones are the red-green signal (L-M), the yellow-blue signal ((L+M)-S), and the achromatic signal (L+M). With respect to the chromatic channels, if $L-M > 0$, then the signal causes you to have an experience as of red. If $L-M < 0$, then the signal causes you to have an experience as of green. Likewise, if $(L+M)-S > 0$, then the signal causes you to have an experience as of yellow, and if $(L+M)-S < 0$, then the signal causes you to have an experience as of blue. With respect to the achromatic channels, if $L + M > 0$, then the signal causes you to have an experience as of white, and if $L + M < 0$, then the signal causes you to have an experience as of black. With respect to any channel, if its value is 0, then its signal causes you to have an experience as of gray.

With these facts in mind, the rough idea is that blue is more similar to purple than to green in that the manifestations of blue and purple but not green are disposed to affect the S cone-types more than both the M and L cone-types combined. Let me explain this proposal in more detail. According to reflectance dispositionalism, colors are dispositions

to reflect certain proportions of (normal) incident light (in normal conditions).³⁵ So, the manifestations of blue, purple, and green, being dispositional properties according to this theory, are certain proportions of reflected incident light. Hence, according to the proposal, blue is more similar to purple than to green in that the manifestations (reflected incident light) of both blue and purple but not green are disposed to affect the S cone-types more than both the M and L cone-types.

I believe that this response can explain (more or less) why in the actual world R_b is more similar to R_p than R_g and so would defeat a non-modal version of the argument from structure, but the reply is weak against the modal version with which I am concerned. My argument runs as follows: B&H's idea is that R_b is more similar to R_p than to R_g in that the manifestations of R_b and R_p , certain proportions of incident light, both instantiate the disposition to affect the S cone-types more than the M and L cone-types combined, while the manifestation of R_g , also a certain proportion of incident light, does not instantiate the disposition to affect the S cone-types more than the M and L cone-types combined. Whether a certain proportion of light instantiates the disposition to affect the S cone-types more than the M and L cone-types combined is dependent on the laws of physics. However, since Hume most philosophers have held that at least some laws are contingent (Carroll, 2004, p. 25). Thus, in order for the proposal to be widely convincing, B&H must argue that *necessarily*, the manifestations of R_b and R_p both instantiate the disposition to affect the S cone-types more than the M and L cone-types combined, while the manifestation of R_g *necessarily* does not instantiate the disposition to affect the S cone-types more than the M and L cone-types combined. B&H provide no such

³⁵ It seems that B&H (p. 15) think that the type of light required for this is equal energy illuminant. So, perhaps they would want to define incident light as 'equal energy light.' I am not sure about the conditions though.

argument. Thus, I believe that their proposal is ineffective, at least as it stands, against the modal version.

The second objection to Not-Similar is due to David Hilbert (1987, p. 117-118). Hilbert's idea is based on a series of psychophysical experiments designed to test Land's retinex theory (McCann et al, 1976; Land, 1977). Land's theory is that the observed color of an image can be determined by calculating the lightness values for the image within the short-, middle-, and long-wavelength bands. Land defines 'lightness' as a perceptual property within the achromatic dimension that results from comparing the luminance values of the entire visual field. The wavebands are those waves of light that correlate with the spectral sensitivities of the S, M, and L cones. The calculation of lightness results in lightness triplets that were empirically determined to designate the color of the image (Thompson, 1995, p. 124).

Experiments performed to test the retinex theory found that lightness is correlated with scaled integrated reflectance (McCann et al, 1976). One gets a scaled integrated reflectance by integrating a reflectance over a waveband then scaling it so that lightness increments correspond equally to reflectance increments. It was found that if this procedure is done over all three wavebands (which correspond to the spectral sensitivities of the cone photoreceptors) instead of just one, then the result, called a 'triplet scaled integrated reflectance,' is able to predict how an object will appear while viewing certain Mondrian displays of arbitrarily arranged pieces of colored paper. Surfaces that had the same triplet scaled integrated reflectance in the experimental setting typically appeared the same color, but surfaces with different triplet reflectances generally appeared different in color (Thompson, 1995, p. 124-125).

With these empirical facts in mind, Hilbert's proposal is to preserve the resemblance relations between the colors via these triplet integrated reflectances. More precisely, Hilbert says that the resemblance relations can be captured using a three-dimensional space, the axes of which are the reflectance values integrated over each of the three wavebands. The resemblance relations are captured by this three-dimensional space, because they are modeled by the relative distances among the reflectance triplets (Thompson, 1995, p. 125).³⁶ Mathematically, these distances can be portrayed as follows: First, assume λ ranges over the wavelengths of the visible spectrum, and R_s , R_m , and R_l are the wavelengths by which the three cone-types are affected. With this being said, "the metrical distance $p(h_1(\lambda), h_2(\lambda))$ between reflectances $h_1(\lambda)$ and $h_2(\lambda)$ is equal to the three-dimensional Euclidean distance between the triples $\langle \int_{R_s} h_1 d\lambda, \int_{R_m} h_1 d\lambda, \int_{R_l} h_1 d\lambda \rangle$ and $\langle \int_{R_s} h_2 d\lambda, \int_{R_m} h_2 d\lambda, \int_{R_l} h_2 d\lambda \rangle$, or the square root of $\{(\int_{R_s} h_1 d\lambda - \int_{R_s} h_2 d\lambda)^2 + (\int_{R_m} h_1 d\lambda - \int_{R_m} h_2 d\lambda)^2 + (\int_{R_l} h_1 d\lambda - \int_{R_l} h_2 d\lambda)^2\}$ " (Cohen, 2003a, p. 81).

Unfortunately, Hilbert's attempt has been discovered not to work. If Hilbert's proposal were correct, the similarity relations would correlate with the mentioned relative distances between the reflectance triples. However, it is now a known empirical fact that the relative distance between the triples only *very* roughly correlate with the resemblance relations between the colors (Thompson, 1995, p. 124-133). Hilbert conceded this fact in Byrne and Hilbert 1997 in which he says, "[T]he space of triples provides only a very loose approximation to the similarity relations among the colors" (p. 285, note 32).

³⁶ It is important to note that Hilbert's response requires that we identify the colors with these integrated triples. Byrne and Hilbert (1997, p. 285, note 32) admit as much. So, technically Hilbert's defense would not save reflectance dispositionalism as defined even if it worked, but this is not worth getting into.

2. 2: Reject Unity

Three objections can be made against Unity. I think that none of them can succeed. The first argument against Unity is based on empirical results. Crane and Piantinida (1983) found that under certain experimental conditions subjects reported seeing reddish-green and bluish-yellow. Billock, Gleason, and Tsou (2001) have replicated the experiment. Both experiments were based on the idea that stabilizing a boundary between two colors on the retina of a subject would cause one's brain to fill in the boundary (Krauskopf, 1963). With this in mind, Crane and Piantinida sought to see how the brain would react if they stabilized a boundary between red and green on a subject's retina and later a boundary between blue and yellow. They found that knowledgeable subjects such as psychologists and psychophysicists reported experiencing red-green in the former case and yellow-blue in the latter.

With this experiment in mind, the argument against Unity runs as follows: (1) Assume Unity is true. (2) If Unity is true, then the hue circle is a closed space. What I mean by 'closed space' is that necessarily the hue circle does not allow the addition of any new hues. The reason for (2) is twofold. (a) The adding of a new hue to the circle would require displacing a hue already in the circle (Westphal, 1987, p. 123), and (b) if a color were displaced, the resemblance relations between the colors would be different than they are. However, as the argument goes, (3) empirical research has found that under certain experimental conditions, subjects report having experiences as of red-green and yellow-green. (4) The best explanation of the subject's reports is that they really are having experiences as of reddish-green and yellowish-green. (5) If it is possible to have an experience as of reddish-green and yellowish-green, then these are colors. The

rationale behind (5) is as follows: (c) If a subject has an experience as of a color, then something must instantiate that color, and (d) a color can be instantiated iff it is a color. (6) Thus, the hue circle is not a closed space (from 3, 4, 5). (7). Unity is false (from 2, 6).

I believe that this argument cannot succeed. There are obviously a lot of questionable steps, but I am just going to focus on (6) in order to avoid moving into adjacent territory. The problem with (6) is that it does not follow from (3), (4), and (5). Rather, it *only* follows from (3), (4), and (5) that there are colors that are new to us, but this is compatible with the hue circle being a closed space. After all, just because a new color is discovered does not imply that any hues have been added to the hue circle.³⁷ It may be the case that there are colors in the hue circle that we do not normally see, and that the relevant experiments allow us to see at least some of these colors. With this being said, it is implausible that we can get much of a grasp about what these novel colors are from verbal reports. This is because our current concepts of the colors are confined to those colors that we normally see, and so we are going to be unable to coherently talk about novel colors without a lot of conceptual training. I for one have very little grasp of what the participants meant by ‘red-green’ and ‘yellow-green’.

The second argument against Unity is due to Cohen (2003a, p. 91-92). Cohen’s argument does not show that Unity is false, rather it attempts to undermine our intuitions about Unity. His argument is as follows: (1) What is really intuitive is not Unity but that our experiences as of color have their resemblance relations necessarily. This intuition leads us to believe that Unity is true, because (2) we are disposed to mistake properties of our experiences as of color for properties of the colors. Call this premise ‘Mistake.’ (3)

³⁷ Similar mistakes to this one are probably made by Cohen (2004; 2009) (see part 3.2), and by Allen (2009a) and Byrne and Hilbert (2007b) (see part 3.3).

Thus, our intuitions about Unity are illogically inherited from our intuitions about our experiences as of color (from 1, 2). (4) Therefore, we ought not to trust our intuitions with regard to Unity (from 3).

Cohen's attempt to undermine Unity is extremely weak. The reason is that it is implausible that we are prone to mistake properties of our experiences as of color for properties external to us. Here is the argument. Assume Mistake is true. Experiences as of color are properties of people, while colors are properties of objects. Thus, assuming Mistake, when we focus on what we experience, we confusedly attend to properties of people. However, it is false that when we focus on what we experience, we accidentally attend to properties of people. Rather, the transparency of experience shows that when we focus on what we experience, we are attending to properties of external objects (Pautz, 2006, p. 557). Therefore, Mistake is false. Without Mistake, Cohen's attempt to undermine Unity cannot succeed.

2. 3: Argument from structure is invalid

The third attempt to defend the reflectance dispositionalist against the argument from structure is to reject the move from Unity and reflectance dispositionalism to step four, i.e. necessarily R_b is more similar to R_p than R_g . The way this is done is by saying that Unity does not mean what we think it does. Thus, the logical form of Unity is not what it appears to be. This can be presented more politically by saying that step four rests on a mistake about what it takes for Unity to be true. According to my opponent the truth condition for Unity is that necessarily experiences as of blue resemble experiences as of purple more than experiences as of green (Shoemaker, 1991, p. 519; Lewis, 1997a, p.

330; Mclaughlin, 2003, p. 115; Cohen, 2003a, p. 88). Call this “the experiential account.” If the experiential account is correct, it clearly does not follow from Unity and reflectance dispositionalism that (4) R_b is necessarily more similar to R_p than R_g . Thus, the argument from structure would be invalid if this objection were to go through.

This reply is unconvincing. The problem is that the claim that the experiential account is the right one runs against what Westphal (1987, p. 125), Hardin (1988, p. 66), Boghossian and Velleman (1991, p. 95), Pautz (2006), Allen (2009, p. 205), and I think Unity means. English speakers have a substantial degree of privileged access to the truth conditions of their beliefs and assertions. That is to say English-speaking subjects usually know what their words mean. Of course, it may be that we do not *always* know what our words mean, as it is perhaps possible given semantic externalism and unobvious analyticities that we sometimes do not (Pautz, 2006, p. 549). Nevertheless, I take it that if it is admitted that English speakers have substantial access to what their words mean, then the friend of the experiential account must say more to motivate their position that Unity does not mean what many philosophers (including myself) think it means: Necessarily, blue is more similar to purple than to green.

In order to further strengthen my position, assume that my proponents and I am wrong about what Unity means. That is, assume that Unity means what the experiential account says it does: Necessarily, experiences as of blue are more similar to experiences as of purple than experiences as of green. Suppose someone says, “necessarily squares are more similar to rectangles than to circles.” By analogy with the experiential account, one should hold that what this sentence means is that necessarily experiences as of squares are more similar to experiences as of rectangles than experiences as of circles.

However, it must be admitted that the experiential account of shapes is wrong headed. We know that the English sentence “necessarily squares are more similar to rectangles than to circles” does *not* mean that necessarily experiences as of squares are more similar to experiences as of rectangles than experiences as of circles. Rather, we know that “necessarily squares are more similar to rectangles than to circles” means that necessarily squares are more similar to rectangles than to circles. As we know that the experiential account is false in the case of shapes, we have good reason to hold that it is wrong in the case of colors as well (Pautz, 2006, p. 550). So, the proponent of the experiential account must say a lot more to motivate their position than they have done.

Moreover, I am skeptical about whether there is any more that could be said in favor of the experiential account at the expense of commonsense. The intentional facts are somehow determined by the non-intentional facts. So, if we are wrong about what Unity means, there must be some non-intentional fact unusual to the case of color that explains why we are confused. However, all relevant non-intentional facts in the color case seem quite ordinary. Certainly they are not relevantly different from the non-intentional facts that determine what we mean by English sentences about the resemblance relations between shapes (Pautz, 2006, p. 552). Thus, there does not seem to be any way to motivate the experiential account.

Section 3: The objection from metamers

Metameric objects are ones that have distinct reflectances yet appear to have the exact same (determinate) color to the majority of normal observers in normal viewing

conditions.³⁸ Metameric phenomena do occur in nature but are most prevalent with man-made paints. For example, two Subaru sedans that appear red pearl (or “redp” for short) to normal observers under normal viewing conditions plausibly have distinct reflectances. We know that metameric phenomena occur, because the human eye has only three receptor types with broad spectral sensitivity and hence is unable to determine the differences between all reflectances (Schiffman, 2001). Thus, it is physically possible for two reflectances R_{redp} and R_{redp1} to be sufficient to cause experiences as of red pearl in most normal observers in normal conditions.

With these facts in mind, the objection from metamers is as follows: Assume that red pearl is identical with the reflectance R_{redp} (that is, assume reflectance dispositionalism is true). The only reason to choose R_{redp} over R_{jade} as identical with being red pearl is that R_{redp} but not R_{jade} is sufficient to cause experiences as of red pearl in most normal observers in normal conditions. Hence, the reflectance dispositionalist must subscribe to something like the following: For any reflectance x , if x is sufficient to cause experiences as of color y in most normal observers in normal conditions, then $x = y$. Call this ‘Sufficient-Cause.’³⁹ Now, consider that two distinct reflectances R_{redp} and R_{redp1} are both sufficient to cause experiences as of red pearl in most normal observers in normal conditions. By Sufficient-Cause, it follows that red pearl is identical to R_{redp1} as well as R_{redp} . After all, both of these properties are sufficient to cause experiences as of red pearl

³⁸ B&H attempt to call metameric objects into question, because they note, among other things, that metameric phenomena seldom occur in nature (2003a, p. 10). However, as the objection from metamers should make clear, the physical possibility of metameric objects alone is sufficient to cause trouble for reflectance dispositionalism.

³⁹ Sufficient-Cause can be thought of as a piece of reference fixing or a piece of meaning giving. If it were the former, the issue of whether an object is sapphire blue in a world would depend on whether the object has the micro-structural property responsible for objects looking sapphire blue in the actual world. If it were the latter, the question of whether an object is sapphire blue in a world would depend on whether the object causes experiences as of sapphire blue in that world.

in most normal observers in normal conditions. One thing cannot be identical with two. Thus, we should conclude that red pearl is not R_{redp} .

The objection from metamers, as I see it, then, is different from the problem as often envisaged in the literature. First, I clearly do not conceive of the objection from metamers as an epistemological problem. That is, I do not conceive of it as a problem with how to pick out the relevant reflectance properties given that more than one reflectance property can appear the same color. Thus, my conception of the objection from metamers is different from the problem as conceived by Michael H. Brill (2003), Rolf G. Kuehni (2003), and Rainer Mausfeld & Reinhard Niederée (2003) in their replies to B&H. I do not think that the epistemological interpretation is a serious problem for reflectance dispositionalism, because it is a metaphysical thesis on color. Second, I do not see the objection from metamers as the unintuitive consequence of reflectance dispositionalism that reflectances that appear the same color are actually different colors. Hence, the objection from metamers, as I understand it, is different from the problem as comprehended by Berit Brogaard (2010b) and Michael Watkins (2005).

3. 1: B&H's defense and its ineffectiveness

B&H suggest that the reflectance dispositionalist thesis can be defended from the actual existence of metameric objects by modifying the thesis in such a way that any determinate color is identical with a set (or a type) of reflectance properties (2003a, p. 10-11). For example, the color red pearl = the set of reflectances $\{R_{\text{redp}}, R_{\text{redp1}}, R_{\text{redp2}}, R_{\text{redp3}}\}$ that are sufficient to cause experiences as of red pearl in most normal observers in normal

conditions.⁴⁰ According to B&H's first condition, any plausible physical theory of color will identify the colors with physical properties (2003a, p. 8). Thus, it is unclear whether B&H can say that the colors are sets, because it is unclear whether sets can be understood as physical properties in the narrow sense under which they seem to understand the notion of 'physical.' However, perhaps there is a way to understand sets in which they can be considered physical properties more or less. For example, perhaps we can understand a set of things as the fusion of those things.

Regardless, if the reflectance dispositionalist assumes that colors are sets of reflectances, he must acquiesce that there are no objects that instantiate color properties. The argument runs as follows: Assume red pearl is the set $\{R_{\text{redp}}, R_{\text{redp1}}, R_{\text{redp2}}, R_{\text{redp3}}\}$ that is sufficient to cause experiences as of red pearl in most normal observers in normal conditions. Since a reflectance property is a disposition of an object to reflect light at a certain wavelength of the visible spectrum, an object can only have one reflectance property at any given time. No object, then, can instantiate the set of reflectances $\{R_{\text{redp}}, R_{\text{red1p}}, R_{\text{red2p}}, R_{\text{red3p}}\}$. It follows that no object can be red pearl. So, the assumed definition of red pearl commits the reflectance dispositionalist to an eliminativist conclusion about red and *mutatis mutandis* for the other colors. Thus, the reflectance dispositionalist must accept that objects appear to instantiate color properties but no object is actually colored. This is not a conclusion that most people who hold realist views including B&H would want to accept. It is especially not a conclusion we should accept given that there is no good motivation for the set-theoretic view under consideration.

⁴⁰ It is worth noting that this view is not really a dispositional view on color. Rather, according to my taxonomy it is instead a categorical view on color. I shall discuss it in this chapter anyway. Given the dialectic, it is a natural progression from the dispositional view, and so it would be odd not to talk about it here.

A likely retort to my above objections is say that the colors are identical with disjunctive properties.⁴¹ A disjunctive property is, for example, the property of being P_1 or P_2 or P_3 . Disjunctive properties are physical properties (or at least seem more physical than sets) that objects can instantiate. Even with this change, B&H's defense against the problem of metamers would be ineffective. I shall provide the argument in terms of sets and disjunctive properties, as it works equally well for both. The argument goes like this. Assume that red pearl is identical with the set s_{rp} $\{R_{redp}, R_{redp1}, R_{redp2}, R_{redp3}\}$ (or the disjunctive property d_{rp} R_{redp} or R_{redp1} or R_{redp2} or R_{redp3}) of reflectances that are sufficient to cause experiences as of red pearl in most normal observers in normal conditions. The only reason to hold that set s_{rp} (or disjunctive property d_{rp}) is identical with red pearl instead of some other set s_j $\{R_{jade}, R_{jade1}, R_{jade2}, R_{jade3}\}$ (or disjunctive property d_j R_{jade} or R_{jade1} or R_{jade2} or R_{jade3}) is that the reflectances that compose set s_{rp} (or disjunctive property d_{rp}) but not set s_j (or disjunctive property d_j) are sufficient to cause experiences as of red pearl in most normal observers in normal conditions. So, B&H must be implicitly appealing to something like the following variant of Sufficient-Cause: For any set x (or disjunctive property x), if x 's members or disjuncts are sufficient to cause experiences as of color y in most normal observers in normal conditions, then $x = y$.⁴² Call this 'Set-Sufficient-Cause.' Now, it seems that in addition to R_{redp} , R_{redp1} , R_{redp2} , and R_{redp3} there is another reflectance R_{redp4} that is also sufficient to cause experiences as of

⁴¹ Another possible reply is to appeal to domain specific reductions (see part 3.1). I will not discuss this strategy here for two reasons. First, proponents of reflectance dispositionalism do not appeal to unpopular domain specific reductions, and second it is unclear what domains would be relevant to reflectance properties. I consider domain specific reductions in part 3.1 even though they are not particularly popular, because they are close at home with micro-structuralism. This is because micro-structuralism was a somewhat popular view on color around the same time that domain specific reductions were being discussed in the literature. What I say in part 3.1 about domain specific reductions applies mutatis mutandis to any attempt to use the strategy here.

⁴² This premise can also be understood as meaning giving or reference fixing.

red pearl in most normal observers in normal conditions. Thus, given Set-Sufficient-Cause, red pearl can be identical with both the set s_{rp} (or the disjunctive property d_{rp}) and the set $s_{rp1} \{R_{redp4}\}$ (or the disjunctive property $d_{rp1} R_{redp}$ or R_{redp1} or R_{redp2} or R_{redp3} or R_{redp4}). One thing cannot be identical with two. So, the reflectance dispositionalist ought to conclude using his reasoning that red pearl is not identical with set s_{rp} (or disjunctive property d_{rp}) and mutatis mutandis for the other colors.

B&H may attempt to deny that R_{red4} is sufficient to cause experiences as of red pearl in most normal observers in normal conditions. However, I believe that we have excellent grounds for holding that B&H cannot easily deny this premise. These grounds are based on the following argument: Assume, as we have been doing, that R_{redp} , R_{redp1} , R_{redp2} , and R_{redp3} all are sufficient to cause experiences as of red pearl in most normal observers in normal conditions. Having made this assumption, there is no reason that does not beg the question against the reflectance dispositionalist's opponent to hold that what is true of R_{redp} , R_{redp1} , R_{redp2} , and R_{redp3} is not also true of R_{redp4} . This is clear once we consider the fact that R_{redp4} can differ from R_{redp3} by a minuscule amount not recognizable by the human eye and likewise for R_{redp5} and so on. Therefore, we ought to hold that there is a reflectance R_{redp4} that is sufficient to cause experiences as of red pearl in most normal observers in normal conditions, and mutatis mutandis for R_{redp5} and so on. B&H, then, cannot easily deny this premise.

3. 2: Defining the colors circularly

In a last ditch effort to defend reflectance dispositionalism, B&H may try to define the colors circularly in terms of sets (or disjunctive properties) whose members (or disjuncts)

cause experiences of the relevant color in most normal observers in normal conditions. For example, red pearl = the set s_{rp} of reflectance properties (or the disjunctive property d_{rp}) such that s_{rp} includes all the reflectance properties that are sufficient to cause experiences as of red pearl in most normal observers under normal conditions. B&H effectively do just this when they identify, for example, red pearl with those proportions of hue-magnitudes that can stimulate the opponent processing system so as to produce experiences as of red pearl (2003a, p. 15). Under this strategy, the set s_{rp} (or the disjunctive property d_{rp}) contains all the reflectance properties that can be sufficient to cause experiences as of red pearl in most normal observers under normal conditions. Hence, any reflectance property R_{redpn} that causes experiences as of red pearl in most normal observers under normal conditions is in the set (or is a disjunct).

An immediate problem with this approach is that the argument I used to defend R_{redp4} being sufficient to cause experiences as of pearl red (in most normal observers in normal conditions) demonstrates that the set s_{rp} (or disjunctive property d_{rp}) would have to be infinite to capture all the reflectance properties that typically cause experiences as of red pearl. So, we can never know exactly what the colors are given this move. This is particularly a problem for a view with such a weak motivation as the one being considered. Whatever is said about this, defining a set in terms of the color with which it is identical cannot avoid the objection from metamers. My argument runs as follows: Assume that red pearl is identical with *the* set s_{rp} of reflectance properties (or the disjunctive property d_{rp}) such that s_{rp} (or d_{rp}) includes all metaphysically possible spectral reflectance properties that can be sufficient to cause experiences as of red pearl in most normal observers under normal conditions (B&H's response). So, the set s_{rp} *itself* (or the

disjunctive property d_{rp} itself) is identical with being red pearl. Being red pearl is sufficient to cause experiences as of red pearl in most normal observers in normal conditions. Hence, the set s_{rp} itself (or the disjunctive property d_{rp} itself) causes experiences as of red pearl in most normal observers in normal conditions. So, by Set-Sufficient-Cause, red pearl is identical with both set s_{rp} (or the disjunctive property d_{rp}) and the set of set s_{rp} (or the property of being the disjunctive property d_{rp} or R_{redp} , R_{redp1} , R_{redp2} , or R_{redp3} and so on). One thing cannot be identical with two. Thus, by the reflectance dispositionalist's own thinking, it follows that red pearl is not identical with the set s_{rp} (or the disjunctive property d_{rp}) and mutatis mutandis for the other colors.

A likely defense is to argue that there are consistent set theories that allow for self-membership. In my opinion, this type of response is a non-starter. I doubt B&H would be comfortable with holding that reflectance dispositionalism is true only if ZF is false. (ZF does not allow self-membership.) A better reply is to adopt the disjunctive property approach instead of the set theoretic one, and say that the property of being the disjunctive property d_{rp} or R_{redp} , R_{redp1} , R_{redp2} , or R_{redp3} and so on is identical to the disjunctive property d_{rp} . This response commits B&H to being realists about disjunctive properties. So, B&H are committed to saying that the property of being a or b is different from being a or being b . However, it is difficult to see how someone can hold a view of property identity that allows the property of being the disjunctive property d_{rp} or R_{redp} , R_{redp1} , R_{redp2} , or R_{redp3} and so on to be identical with the disjunctive property d_{rp} at the same time as being a realist about disjunctive properties.

Let me explain. Generally speaking, there are three views on property identity: The first is that any two properties are identical iff they have the same extension; the

second is that any two properties are identical iff they have the same causal powers; and the third is that properties are individuated almost as finely as language. Of these three views, the third view on property identity is clearly unavailable to the reflectance dispositionalist who wants to say that the property of being the disjunctive property d_{rp} or R_{redp} , R_{redp1} , R_{redp2} , or R_{redp3} and so on and the disjunctive property d_{rp} are identical. So, B&H must accept either the first view or the second. The first view is in tension with being a realist about disjunctive properties, because the property of having a or b is necessarily coextensive with being a or being b . The second view could perhaps be shown compatible with being a realist about disjunctive properties but only if it is also shown to be compatible with the disjunctive property d_{rp} or R_{redp} , R_{redp1} , R_{redp2} , or R_{redp3} , etc being different from the disjunctive property d_{rp} . The reason is that if one accepts that the property of being a or being b has causal powers above its logical parts being a or being b , then it seems one has to say the same about the property being d_{rp} or R_{redp} , R_{redp1} , R_{redp2} , or R_{redp3} , etc.

Another possible response to my argument is to reject Set-Sufficient-Cause and replace it with what I will call ‘Reflectance Set-Sufficient-Cause.’ Reflectance Set-Sufficient-Cause is as follows: For any set x (or disjunctive property x), if (1) x 's members (or disjuncts) are sufficient to cause experiences as of color y in most normal observers in normal conditions, and (2) x 's members (or disjuncts) are only reflectances, then $x = y$. Reflectance Set-Sufficient-Cause blocks the above implication of its cousin that red pearl is identical with both set s_{rp} (or the disjunctive property d_{rp}) and the set of set s_{rp} (or the property of being the disjunctive property d_{rp} or R_{redp} , R_{redp1} , R_{redp2} , or R_{redp3} and so on). Without this step, my argument fails.

Unfortunately, there is no principled reason for the reflectance dispositionalist to adopt Reflectance Set-Sufficient-Cause over its simpler cousin. The reason is that the reflectance dispositionalist must hold (a) that sets (or disjunctive properties) are physical properties and (b) that sets (or disjunctive properties) can be sufficient to cause experiences as of color in most normal observers in normal conditions. The reason for (a) is B&H's first condition on any plausible physical theory of color together with the fact that the proposal being defended by my opponent states that colors are identical with sets (or disjunctive properties). The reason for (b) is B&H's second condition on any plausible physical theory of color combined with the same fact as above. The problem with B&H holding (2) should now be clear. If sets (or disjunctive properties) are physical properties and can be sufficient to cause color experiences, then why are only sets of reflectances (or disjunctions of them) privileged with being the colors? The only answer that appears forthcoming is that Reflectance Set-Sufficient-Cause must be true if reflectance dispositionalism is true, but this is not a principled response.

Conclusion

In this chapter, I examined the view called reflectance dispositionalism that the colors are identical with dispositions to reflect certain proportions of incident light at each wavelength of the visible spectrum. There are three things I did. First, I sharpened reflectance dispositionalism and explained its motivation (section 1). Second, I argued that reflectance dispositionalism succumbs to the modal version of what I call the "objection from structure" (section 2). Roughly, the objection states that reflectance dispositionalism is unable to account for the resemblance relations that necessarily hold

between the colors. The third goal of this chapter was to argue that reflectance dispositionalism succumbs to what I call the “objection from metamers” (section 3). This objection stems from the empirical fact that objects with distinct reflectances can appear to have the same color to normal observers under normal viewing conditions.

Part 2.3: A General Argument Against Dispositionalism

In this chapter, I present a general argument against the colors being dispositions. A property P is dispositional =df for some manifestation M and circumstances C : P is identical with the disposition to M in C . Intuitively, dispositions are analyzable by something like the simple conditional analysis (SCA). The SCA is as follows: x has the disposition to M in C just in case if x were in C , x would M . To develop my general argument against dispositionalism, I first argue for a revised version of the SCA (section 1). Having argued for the revised SCA, I then show that the colors are not analyzable by the proposed analysis (section 2). I do this by presenting the general argument form and then defending the argument.

Section I: The revised SCA

In order to argue for the revised SCA there are three major things I must do. In section 1.1, I provide a defense of the SCA from myriad popular counterexamples. In 1.2, I examine Mellor's (1974) case that some non-dispositional properties imply counterfactuals. In section 1.3, I propose the revised SCA and defend it from various objections.

1. 1: Defense against counterexamples

In this section, I shall defend the SCA against counterexamples. It is important to note here that in engaging the counterexamples, I am only concerned with dispositional properties explicitly expressed in the form 'the disposition to M in C .' This is because I want to avoid debating what the M and C are for various conventional dispositions like

being fragile. With this being said, the structure of this section is as follows: In 1.1.1, I shall discuss Martin's (2008, p. 15) electro-fink counterexamples. In 1.1.2, I shall focus on Smith (1977, p. 440) and Johnston's (1992, p. 232) Mimic counterexamples. In 1.1.3, I will discuss Johnston's (1992, p. 233) mask counterexamples and then Bird's (1998) antidotes. Finally, in 1.1.4, I shall discuss the intrinsic dispositions thesis (Lewis, 1997b; Molnar, 1999; Bird, 1998; Mellor, 1974).

1. 1. 1: Martin's finks

The first counterexample against the SCA that I want to discuss is due to Martin (2008, p. 15). By the SCA, x has the disposition to conduct electricity from itself to a conductor iff if x were touched by a conductor, x would conduct electricity from itself to the conductor. Imagine a wire that does not have the disposition to conduct electricity from itself to a conductor if contacted by a conductor. Now, envisage that with a machine called a 'fink' attached, were a conductor to touch the wire, electricity would flow from the wire to the conductor. The argument holds that the correct interpretation of this thought experiment is that with the fink attached, were the wire touched by a conductor, electricity would flow from the wire to the conductor, but the wire does not have the disposition to conduct electricity from itself to a conductor. If this interpretation is correct, the thought experiment is a counterexample to the SCA in the right to left direction: If a conductor contacted the wire, electricity would flow from it to the conductor, but the wire does not have the disposition to conduct electricity if contacted.

This fink can also function in reverse. Imagine a wire that has the disposition to

conduct electricity from itself to a conductor if contacted by a conductor. Next, picture that with a machine called a 'reverse-fink' attached, were a conductor to touch the wire, no electricity would flow from the wire to the conductor. The argument holds that the correct interpretation of this thought experiment is that the wire has the disposition to conduct electricity, but that with the reverse fink attached, were the wire touched by a conductor, it would not transmit electricity from itself to the conductor. If the argument's position is correct, then the thought experiment is a counterexample to the SCA in the left to right direction: The wire has the disposition to conduct electricity, but it is false that if a conductor contacted the wire, then electricity would flow through the wire to the conductor.

Martin's counterexamples cannot succeed. Martin's fink counterexample requires that it must be simultaneously true of the wire that were a conductor to touch the wire, electricity would flow from the wire to the conductor but false that the wire has the disposition to conduct electricity from itself to a conductor. However, it seems that it is absurd that both of these conjuncts can be true simultaneously. So, I would say that the correct understanding of Martin's thought experiment, contrary to his ambitions, is that the fink gives the wire the disposition to conduct electricity if touched by a conductor. Martin's reverse-fink counterexample requires that it must be simultaneously true of the wire that it is disposed to conduct electricity from itself to a conductor, but that were a conductor to touch the wire, no electricity would flow through the wire to the conductor. Similarly to the fink case, however, it seems to me that both of these conjuncts cannot be true at the same time. Hence, I would say that Martin is incorrect about how we should interpret his thought experiment. Namely, I would say that the correct understanding is

that the wire attached to the reverse-fink does not have the disposition to conduct electricity if contacted by a conductor. As I think that Martin's interpretations of the fink and reverse fink thought experiments are wrong, I reject his arguments.

1. 1. 2: Smith and Johnston's Mimics

Martin's counterexamples to the SCA fail, but there are others. The first of these was originally developed by A. D. Smith (1977, p. 440) and honed by Mark Johnston (1992, p. 232). Both Smith and Johnston's counterexamples are known as mimics. By the SCA, x has the disposition to remain intact if dropped iff if x were dropped, x would remain intact. Now, visualize a holy chalice that does not have the disposition to remain intact if dropped. Next, imagine a holy angel who so loves the chalice that he ensures using magic that were the chalice to drop, it would remain intact. My opponents' interpretation of this thought experiment is that with the angel present, were the chalice dropped it would remain intact, but it is false that the chalice has the disposition to remain intact if dropped. If this interpretation were correct, then the thought experiment would be a counterexample to the SCA in the right to left direction: If the chalice were dropped, it would remain intact, but it is false that the chalice has the disposition to remain intact if dropped.

The angel, like the Fink, can also operate in reverse. First, Imagine a holy chalice that has the disposition to remain intact if dropped. Now, picture a fallen angel who so dislikes the holy chalice that he ensures using magic that it is false that were the chalice dropped, it would remain intact. My opponents claim that the correct interpretation of this thought experiment is that the chalice has the disposition to remain intact if dropped, but

that with the angel present it is false that were the chalice dropped it would remain intact. If this interpretation were correct, the thought experiment would be a counterexample to the SCA in the left to right direction: It is true that the chalice has the disposition to remain intact if dropped, but it is false that if the chalice were dropped, then it would remain intact.

I do not think that Johnston's counterexamples can succeed. Smith and Johnston's holy angel counterexample requires that it must be simultaneously true of the chalice that were it dropped, it would remain intact, but that it does not have the disposition to remain intact if dropped. However, similarly to what I said in response to Martin, it seems absurd that both of these conjuncts can be true simultaneously. So, I would say that the correct understanding of Smith and Johnston's thought experiment, contrary to their ambitions, is that the holy angel gives the chalice the disposition to remain intact if dropped. The fallen angel counterexample requires that it must be simultaneously true of the chalice that it has the disposition to remain intact if dropped but false that were the chalice dropped, it would remain intact. However, like I have been saying, it seems that both of these conjuncts cannot be true at the same time. Hence, I would say that the correct understanding is that a chalice in the presence of the fallen angel does not have the disposition to remain intact if dropped. As I do not buy Smith and Johnston's interpretations of their thought experiments, I reject their arguments.

1. 1. 3: Johnston's masks and Bird's antidotes

The third counterexample is also due to Johnston (1992, p. 233) and the fourth to Bird (1998). By the SCA, x has the disposition to break if dropped iff if x were dropped, x

would break. Now, imagine a glass that is disposed to remain intact if dropped. Next, envisage destructive packaging material (e.g. rocks or bricks) that ensures were the glass dropped it would break. The argument's interpretation of this thought experiment is that when surrounded by the material, were the glass dropped, it would break, but that it is false that the glass has the disposition to break if dropped. If this interpretation were correct, the thought experiment would be a counterexample to the SCA in the right to left direction: It is true that were the glass dropped, it would break, but it is false that the glass has the disposition to break if dropped.

The destructive packaging material can also operate in reverse. Imagine a glass that has the disposition to break if dropped. Now, picture protective material (e.g. Styrofoam packaging material) that guarantees that were the glass dropped, it would not break. Johnston's interpretation of this thought experiment is that the glass has the disposition to break if dropped, but that with the protective material attached it is false that were the glass dropped, then it would break. If this interpretation were correct, then the thought experiment would be a counterexample to the SCA in the left to right direction: It is true that the glass has the disposition to break if dropped, but it is false that if it were dropped, then it would break.

Bird's antidotes are last minute masks. Antidotes function best in the left to right direction, so I shall only look at this kind of case. By the SCA, x has the disposition to kill a man if ingested iff if x were ingested by a man, x would kill him. Now, imagine a pill that is disposed to kill a man if ingested. Next, envisage that a man takes the pill and immediately afterwards the antidote. Bird's interpretation of this thought experiment is that the pill has the disposition to kill a man if ingested, but that it is false that if the pill

were ingested by a man, then he would die. If the argument's interpretation were accurate, then the thought experiment would be a counterexample to the SCA in the left to right direction: It is true that the pill is disposed to kill a man if ingested, but it is false that if a man were to ingest it, then he would die.

I reject both Johnston's masks and Bird's antidotes. Antidotes are just last minute masks. So, for simplicity, I will only consider the masking case. The destructive packaging counterexample requires that it be simultaneously the case that were the glass dropped, it would break, but that it is false that the glass has the disposition to break if dropped. However, like I said in the previous sub-sections, it is absurd that both of these conjuncts can be true at the same time. So, I disagree with Johnston's interpretation of the thought experiment. Rather, I say that the destructive packaging gives the glass the disposition to break if dropped. The protective packaging counterexample requires that it is simultaneously the case that the glass has the disposition to break if dropped, but that it is false that were it dropped, it would break. Again, it is absurd that both of these conjuncts can be true at the same time. So, I think that the correct interpretation of the thought experiment is that the protective packaging remove's the glass' disposition to break if dropped. As I reject Johnston's interpretations of the packaging material cases, I reject his counterexamples, and *mutatis mutandis* for Bird's antidote case.

1. 1. 4: The intrinsic dispositions thesis

A likely worry is that what I have said so far in this section implies that at least some dispositions are not intrinsic. However, many philosophers have held that all dispositions are intrinsic (Lewis, 1997b, p. 148; Molnar, 1999, p. 3; Johnston, 1992, p. 234). An

intrinsic property of anything is a property had by that thing regardless of what is actually going on outside of itself; an extrinsic property of anything is a property that depends on things external to that thing. In response to this worry, I join Mckitrick (2003) and Choi (2009) (amongst others) in accepting that there are extrinsic dispositions. I think that this is the correct view to take, because otherwise one cannot avoid the absurdities discussed above. For example, if one were to hold that all dispositions are intrinsic properties, one must hold that Martin's reverse finked wire retains its disposition to conduct electricity if touched, despite the fact that it would not conduct electricity from itself to a conductor if touched by a conductor. I cannot countenance such a conclusion, as it just seems incoherent. So, I deny the intrinsic dispositions thesis.

Of course, I should not merely reject the intrinsic dispositions thesis if it has overwhelming support. Surprisingly, many have simply accepted the thesis as intuitively true without much argument. I suspect that my opposition finds the intrinsic dispositions thesis to be intuitive because of something like the following rough thinking:

A rubber wire's disposition to not conduct electricity must be intrinsic. No wire made of rubber can be disposed to conduct electricity, regardless of its physical environment. If this is true of rubber wires, it must be true of all dispositions.

Unfortunately, this thinking does not form a valid argument. A general truth cannot be derived from a particular case. Moreover, it does not follow from the fact that it is physically impossible for a rubber wire to conduct electricity that the disposition to not conduct electricity is always intrinsic. The disposition to not conduct electricity can be intrinsic to rubber wires but not to other types of wires. For example, it is physically

possible for there to be a wire whose disposition to not conduct electricity is dependent on the temperature in which it is placed. It is physically true that temperature influences conductivity.

I know of only one well-developed argument in the literature for the intrinsic dispositions thesis, but I do not think that it works. The argument is originally due to Armstrong (1973, p. 11) but what follows is Mckitrick's (2003, p. 172) interpretation:

P1. Imagine a safe glass and an endangered glass.

A. Both the safe glass and endangered glass are fragile

B. The safe glass has protective packaging material and no attacker in sight.

C. The endangered glass lacks protective packaging, is being struck, and will soon break.

P2. The relevant extrinsic properties to the safe and endangered glasses are:

having protective packaging, not having protective packaging, being struck, and not being struck.

P3. A glass's fragility depends on its having properties that are relevant to whether it would shatter if struck.

(4). Both the safe and endangered glasses have properties relevant to whether they would shatter if struck. (from P3 and A)

(5). Neither the endangered nor the safe glass share any extrinsic properties that are relevant to whether they would shatter if struck. (from P2, B, and C)

(6). The properties of the safe glass relevant to whether it would shatter are intrinsic. (from 4 and 5)

(7). Therefore, the safe glass's fragility depends on its intrinsic properties. (from P3 and 6)

Mckitrick (2003, p. 172-173) has pointed out that there are two serious problems with this argument, and I agree. First, it does not show that all dispositions are intrinsic. A general truth cannot be obtained from a specific example. So, even if we assume that Armstrong has successfully described a case in which no extrinsic property of the safe glass is relevant to its fragility, his opponent need only describe one case in which extrinsic factors influence a thing's dispositions. There are many such examples to be had. Imagine a key on Shoemaker's keychain that has the disposition to open his front door. The key could lose the disposition to open Shoemaker's front door without undergoing any intrinsic change. The key could lose the disposition were the lock on Shoemaker's door replaced by one of a different kind (Shoemaker, 1984, p. 221). In addition to Shoemaker's keychain, there are myriad other examples including but not limited to weight, vulnerability, visibility, and recognizability. An object's weight depends on the gravitational field in which it is placed. An object's invulnerability can depend on a nearby defense system. Whether an object is visible can depend on environmental conditions. Finally, whether a man is recognizable is dependent on his environment.

The second problem is that Armstrong's argument fails to show that no extrinsic property of the safe glass could influence its fragility. P2 of Armstrong's argument says that the only relevant extrinsic properties to whether the glasses would shatter if struck are being struck, not being struck, having protective packing, and not having protective

packaging. Why not include fragility on this list? If fragility were included, the safe and endangered glasses would share an extrinsic property relevant to their shattering, namely fragility. So, the argument's conclusion to the effect that the safe glass's fragility is an intrinsic property would not follow. The only immediately obvious answer that Armstrong can give to this question is that fragility is an intrinsic property and so is not an extrinsic property relevant to whether the glasses would shatter if struck. Unfortunately, this answer is clearly question begging.

1. 2: Mellor's triangle

In this section, I examine Mellor's triangle case that some non-dispositional properties imply counterfactuals. In section 1. 2. 1, I shall explain Mellor's (1974) triangle example. In section 1. 2. 2, I will look at Prior's (1981) reply and Mellor's (1982) defense against Prior. Then in section 1. 2. 3, I shall argue that Mellor's reply cannot succeed.

1. 2. 1: Mellor's triangle

Mellor's triangle case is that x is a triangle iff if x 's corners were counted correctly, then the result would be three (Mellor, 1974). It may be tempting to think of this as a counterexample to the SCA. However, this temptation would be misguided, because the SCA says that x has the disposition to M in C iff if x were in C , x would M . Thus, one cannot get from Mellor's triangle case to the absurd conclusion that being triangular is a dispositional property. Nevertheless, Mellor's triangle case is important when discussing an analysis of dispositional properties. This is because Mellor's triangle shows that some non-dispositional properties just like dispositional ones imply counterfactuals, but it

would be preferable if we could use the right side of the SCA to differentiate between dispositional and non-dispositional properties.

Things are worse than they may at first appear from looking at Mellor's case alone. This is because we can get that all non-dispositional properties imply counterfactuals. The argument runs as follows: Imagine two intrinsic non-dispositional properties, Q and U . Now, define a disposition D as the power to manifest state Q if in state U . Hence, our non-dispositional property U implies that if some object were D , it would manifest Q (Cross, 2005, p. 328). In order to aid understanding, let us look at a concrete case. Imagine two non-dispositional properties, being dropped and being broken. Now, define "x is fragile" as x has the disposition to manifest the state being broken if in the state being dropped. So, the non-dispositional property being dropped implies that if x were fragile, x would manifest being broken.

The counterexamples created by the algorithm all involve circular counterfactuals. D is defined as the disposition to manifest Q if in state U . So, the conditional implied by x having U is equivalent to if x were disposed to manifest Q if in state U , then x would Q . What I mean by such counterfactuals being circular is that there is a property built into the antecedent that is also built into the consequent. For example, define "x is fragile" as x has the disposition to manifest the state being broken if in the state being dropped. Hence, the conditional implied by being dropped is equivalent to if x were disposed to manifest the state being broken if in state being dropped, then x would manifest being broken. The importance of this will be clear later. Let us first discuss whether Mellor's triangle implies a circular counterfactual.

1. 2. 2: Prior's reply and Mellor's defense

The question of whether Mellor's triangle implies a non-circular counterfactual hinges on the interpretation of the term "correctly." Elizabeth Prior (1981; 1982; 1985, p. 59-62) argues that "correctly" must refer to the result of counting for the appropriate counterfactual to be implied by x being a triangle, and so the counterfactual implied by Mellor's triangle must be circular. Her argument runs as follows: There are only two options: "correctly" either refers to the result or the method of counting. If "correctly" refers to the method, the implication does not follow. It is metaphysically possible that on some world the laws of nature are different so that systematic perceptual deception occurs whenever one attempts to count a triangle's corners. Whenever someone is given the order to count a triangle's corners in that world he sees and counts five corners instead of three. Hence, the relevant conditional is only implied by x being a triangle if "correctly" refers to the result of counting. Prior says that her counterexample to "correctly" referring to the method of counting should be understood as alluding to the broader point that the manner of counting cannot guarantee getting the right answer.

Mellor (1982) disagrees with Prior's argument. He says that x is a triangle implies that if x 's corners were counted correctly, then the result would be three, where "correctly" is understood as referring to the method. His argument is that given the correct mathematical definition of counting correctly it is impossible for one to count correctly yet get the wrong answer. The mathematical definition of counting a thing's corners correctly, according to Mellor, is to put its corners into a "1-1 correspondence with an initial segment of the sequence of positive integers 1, 2, 3, ... The highest number in the segment is the result of the counting" (1982, p.96). According to Mellor, if

this procedure is followed when counting the corners of a triangle, it is impossible to arrive at an answer other than ‘three.’

1.2.3: My reply to Mellor’s defense

In my opinion, Mellor’s defense against Prior cannot succeed. I agree with Mellor to the extent that when considered abstractly the result of a mathematical operation is its final step. So, if the final step is the right answer, performance of the operation guarantees the correct result. Unfortunately for Mellor, mathematical operations require counters.

Computers, humans, intelligent aliens, and so forth are examples of counters. The result of a counter’s performing a mathematical operation is an effect of the method used.

Specifically, the event referred to by ‘the result of a counter’s executing a mathematical operation’ is an effect of the event referred to by ‘performing the mathematical operation.’ In other words, the event ‘performing the mathematical operation’ is the cause of the event ‘the result of the counter’s executing the mathematical operation.’ For example, when $2+2$ is typed into one’s calculator, the result ‘4’ printed to its screen is an effect of the mathematical operation that it executed.

Given that the result of any counting operation is an effect of the method used, it is possible for a counter to perform an operation that would necessarily get the right answer when thought of abstractly yet obtain the wrong result. In fact, the only way to ensure that counting a triangle’s corners correctly results in getting ‘three’ would be to build the result ‘three’ into the notion of ‘correctly.’ Unless this is done, the failure of counting to bring about the correct answer can occur for myriad reasons including but not limited to physical defects, outside interference, or buggy instructions. For example, a

calculator will fail to print the right result to its screen if there is a faulty internal connection between its screen and its logic board. Similarly, I will fail to arrive at the answer ‘three’ when using Mellor’s method of counting corners if there is, for instance, a lesion to a part of my brain required for counting correctly.

A possible response to my criticism of Mellor is to say that I propose a false dichotomy by tacitly agreeing with Prior that ‘correctly’ must be interpreted to refer either to the method of counting or to the result. My opponent may say that the term “correctly” can also be interpreted to mean not making a mistake, where a mistake is defined as a set of possibilities. The set would include possibilities such as counting the same corner twice, failing to put the corners into a 1-1 correspondence, using the lowest number of the sequence as the result. Thus, according to my opponent, one can say that x is a triangle implies that the result would be three if x ’s corners were counted without making a mistake. The notion of not making a mistake is conceptually distinct from the notion of getting the right answer. So, as the argument goes, if one interprets “correctly” to refer to not making a mistake, then one can avoid the circularity argued to be inherent in the relevant counterfactual implied by Mellor’s triangle.

This response cannot succeed. To ensure that counting a triangle’s corners yields the correct result, the set defined as ‘not making a mistake’ must include all the factors that would result in not getting the result ‘three.’ The problem is that there are endless possible interfering factors. Thus, there is no way to specify the relevant factors without circularly defining them as those factors that interfere with getting the answer ‘three.’ This is the same problem that *ceteris paribus* clauses (and ideal conditions etc) encounter when used to defend the SCA from Martin et al. and why they are useless here too

(Martin, 1994, p. 6; Mumford, 1998, p. 87, and Fara, 2005, p. 51-53). To fill out the *ceteris paribus* clause all possible interfering factors must be specified but these are infinite. Hence, to say that if x 's corners were counted *ceteris paribus*, the result would be three is just to say that if x 's corners were counted, unless something interfered with getting the result that x has three corners, the result would be three.

If this is right, Mellor's triangle example is very similar to the ones that can be generated using the algorithm described in section 1.2.1. Using the algorithm one can get that x is being dropped implies that if x were disposed to manifest being broken if in the state being dropped, then x would manifest being broken. Here being broken is built into both the antecedent and consequent of the relevant counterfactual. Mellor says that x is a triangle implies that if x 's corners were counted correctly, the result would be three. However, as I have argued, x is a triangle does not imply any specifiable counterfactual that does not build the right answer into the notion 'correctly.' So, at best one can say x is a triangle implies that if x 's corners were counted and the counter got 'three,' he would get the result 'three.' Here as with the algorithm one has a case in which being three is built into both the antecedent and consequent. Thus, clearly there is a strong analogy between this case and the algorithm: Both cases are ones in which the relevant counterfactuals are only specifiable if they are circular.

1.3: An analysis and its defense

I believe that based on sections 1.1 and 1.2 that we can develop an analysis similar to the SCA that allows one to differentiate between dispositional and non-dispositional properties. This section is divided into two subsections. In 1.3.1, I shall present my

analysis of dispositional properties. In 1.3.2, I will defend my analysis against some objections.

1.3.1: My revised SCA

We have seen that Martin et al.'s arguments fail to refute the SCA. I admit that Mellor's triangle shows that the SCA is not that useful in that it does not allow us to use its right side to differentiate between dispositional properties and non-dispositional properties.

However, I have shown that the property of being a triangle as well as those generated by the algorithm imply counterfactuals that are only specifiable circularly. Contrary to this, all of the quintessential dispositional properties discussed in this chapter imply counterfactuals that are easily specifiable non-circularly. Thus, there is an immediately obvious way to improve the SCA so as to make it useful. The obvious way to improve the SCA is by adding the constraint that the relevant counterfactual be non-circularly specifiable. Doing so results in the improved SCA: x has the disposition to M in C just in case non-circularly if x were in C , x would M .

I believe that there is a problem with using the improved SCA to differentiate dispositional properties from non-dispositional ones. The issue is that non-circular counterfactuals are necessarily implied by any object whatsoever regardless of its properties. For example, any object x regardless of its properties implies non-circularly, if x were in any circumstances whatsoever, then x would be self-identical. The best way around this problem is to revise the improved SCA so that it is no longer just a modal claim like so.

Revised SCA: Essentially, x has the disposition to M in C iff non-circularly if x were in C , x would M .

The revised SCA avoids the problem just discussed. Let me explain why. x is a triangle implies non-circularly, if x were in any circumstances whatsoever, x would be self-identical. This is because any object whatsoever regardless of its properties implies this counterfactual. However, x is a triangle does not *essentially* imply non-circularly, if x were in any circumstances whatsoever, x would be self-identical. After all, this counterfactual is not essential to x being a triangle. Thus, the revised SCA avoids the relevant problem.

1.3.2: A defense against objections

Troy Cross (2005, p. 328) thinks that non-circularity cannot be used in an analysis of dispositional properties, because circularity is neither peculiar to non-dispositional predicates nor metaphysically relevant. With regard to the former, he asks us to consider the concept of inertial mass, thought of as the disposition to resist acceleration. Inertial mass, he says, is defined partly in terms of force, and force is defined partly in terms of inertial mass. With regard to the latter, Cross says that even if circularity were peculiar to non-dispositional predicates, this would not show a metaphysical distinction between non-dispositional and dispositional properties. Rather, he says that the circularity would only show an epistemic distinction between them.

Cross's arguments are unsuccessful. With regard to his first argument, the term 'inertial mass' does not mean the disposition to resist acceleration. Rather, the term refers to the non-dispositional property mass of an object, as measured by its resistance to

acceleration. In addition, the term ‘inertial mass’ is not defined in terms of force and inertial mass in the sense required for the argument. $F=MA$ does not state that “force” means mass times acceleration. If “force” meant mass times acceleration, it would be discoverable a priori that $F=MA$, but obviously the fact that $F=MA$ is an empirical discovery. $F=MA$ is a law governing the properties referred to as force, mass, and acceleration. The law states, amongst other things, that if an object has a certain mass and acceleration, then it will have a certain force. The law does not give us the meaning of the terms “force,” “mass,” and “acceleration.” Therefore, the concept of inertial mass is neither dispositional nor implies a counterfactual only specifiable circularly.

Cross’s second attempt to block the distinction is unclear. One interpretation of his response is that the debate about circularity is about concepts and so is irrelevant. Under this interpretation the response is misguided. The debate between Mellor, Prior, and myself is not about our concepts. Rather, the debate is about whether the property being a triangle implies that if some object x instantiates it, then if x ’s corners were counted correctly, the result would be three. Prior argues that x being a triangle implies this counterfactual only if ‘correctly’ refers to getting the right answer, and so the counterfactual is circular. Mellor disagrees with this necessary condition and proposes a new understanding of ‘correctly’. I responded to Mellor by defending Prior that the method of counting cannot guarantee the right result. Therefore, I think that it should be clear that the debate is not merely about concepts.

Another way to understand Cross is as saying that a distinction amongst concepts does not imply that those concepts refer to separate entities. Assume that the concept of ‘dispositionality’ implies that essentially x has the disposition to M in C just in case non-

circularly if x were in C , x would M . Hence, the concept of ‘non-dispositionality’ implies that a property is non-dispositional just in case there is no M and C such that for all x : Px essentially implies that non-circularly if x were in C , x would M . Despite these conceptual truths, as the argument goes, it could turn out that these concepts have the same extension. The analogy is with superman and Clark Kent, Hesperus and Phosphorus, or Water and H_2O . For example, the concept ‘Hesperus’ is about the morning star, while the concept ‘Phosphorus’ is about the evening star. However, astronomy has shown us that ‘the morning star’ and ‘the evening star’ both refer to the planet Venus. Similarly, we could learn that the concepts ‘dispositionality’ and ‘non-dispositionality’ both refer to the same kind of property.

This reply cannot succeed. If it turned out that ‘non-dispositionality’ and ‘dispositionality’ referred to the same property, then this property would have to be capable of fulfilling both of these concepts. The concepts ‘Hesperus’ and ‘Phosphorus’ both refer to the planet Venus only if this planet is capable of satisfying the concepts ‘morning star’ and ‘evening star.’ This condition is achieved in the actual world: Both the Earth and Venus rotate around the sun, and this rotation is such that the same planet appears overhead both in the morning and in the evening. However, if things were such that Venus did not appear both in the morning and in the evening, then it could not fulfill the concepts ‘morning star’ and ‘evening star.’ Similarly, the notions ‘Superman’ and ‘Clark Kent’ both refer to Clark Kent only if Clark Kent can satisfy both of these concepts. This just so happens to be the case in the Superman fiction. Similarly, ‘Water’ and ‘ H_2O ’ both refer to H_2O only if H_2O is able to play the role of both itself and water. Many have claimed that this requirement is met in the actual world.

Thus, we can see that the reply being considered rests on whether a single property can fulfill both the roles of ‘non-dispositionality’ and ‘dispositionality.’ Is it possible for one property to do this? The notion of ‘dispositionality’ implies that there is an essentially associated, non-circular counterfactual. The notion of ‘non-dispositionality’ implies that there is no essentially associated, non-circular counterfactual. So, the concepts ‘non-dispositionality’ and ‘dispositionality’ have contradictory implications. How then is a single property to fulfill both of these concepts? A property cannot do two contradictory things at the same time. Perhaps though this is not required. Imagine a metaphorical switch. When a property P’s switch is turned to non-dis, there exists no associated M and C such that essentially Px non-circularly implies that if x were in C, x would M. When P’s switch is dialed to dis, there is an associated M and C such that essentially Px non-circularly implies that if x were in C, x would M. I think it is unlikely that any sense can be made of this metaphorical switch. Regardless, a distinction remains: Non-dispositional properties are those properties with their switch set to non-dis, whereas dispositional properties are those with their switch dialed to dis.

1.4: Summary of section 1

It is intuitive that dispositions are analyzable by something like the simple conditions analysis (SCA). So far in this chapter, I argued for an analysis of dispositional properties similar to the SCA. I first argued that the popular counterexamples against the SCA do not work. Specifically, I argued that fink, mimic, mask, and antidote counterexamples to the SCA all fail. I examined an objection that necessarily, dispositions are intrinsic properties but concluded that this thesis is not a viable defense. Second, I examined

Mellor's claim that some non-dispositional properties in addition to dispositional ones imply counterfactuals. Specifically, I inspected Mellor's triangle example. However, I argued that Mellor's triangle only implies a counterfactual specifiable circularly. In conclusion of section 1, I presented my own revised SCA that allows one to distinguish between dispositional and non-dispositional properties.

Section 2: Argument from the analysis

My argument from the analysis is roughly that the colors cannot be dispositional properties, because they are not analyzable by my revised SCA. Recall that the revised SCA is that essentially, x has the disposition to M in C iff non-circularly if x were in C , x would M . My argument from the analysis is as follows: All dispositions are analyzable by my revised SCA. Thus, if the colors were dispositional properties, then they would be analyzable by the revised SCA. If the colors were analyzable by the revised SCA, then they would essentially imply non-circular counterfactuals. However, the colors only imply counterfactuals circularly specifiable. Therefore, the colors cannot be dispositional properties.

2. 1: Defense of the argument

My argument from the analysis presupposes the premise that the colors only imply counterfactuals circularly specifiable, but why should anyone accept this? One reason is that it seems true a priori, or at least it seems true a priori to me. However, I recognize that others may not agree that the premise seems true. I do not think that there is a direct argument for the premise that could be given without begging the question. So, I shall

argue for it by arguing that all of the dispositional theories discussed hold that the colors are identical with dispositions the counterfactuals of which would have to be circularly specified were they to be implied by an object being colored. I will first do this for internal appearance dispositionalism, then the external variant of this view, and finally for reflectance dispositionalism. When concentrating on internal, appearance dispositionalism, I shall focus on the circular version, but it should be clear that what I say can be applied *mutatis mutandis* to the non-circular version.

2. 1. 2: Internal, appearance dispositionalism

According to internal (circular) dispositionalism, being red, for example, is the disposition to cause an experience as of red (in us) if viewed. So, if internal dispositionalism were the correct view on color, it would follow by my revised SCA that essentially x is red implies non-circularly that if x were viewed, x would cause an experience as of red. It is clear, however, that an object x being red does not imply this counterfactual. The reason for this is that a subject can view x but fail to have an experience as of red because of numerous factors.

An obvious attempt to address the above problem is to modify ‘if viewed’ to say ‘if viewed by normal observers in normal conditions.’ If this constrained version of internal dispositionalism were true, it would follow by the revised SCA that essentially x is red implies non-circularly that if a normal observer in normal conditions were to view x , then x would cause an experience as of red in him. How ought we to understand ‘normal observer in normal conditions’? This is a very difficult question to answer, and many think that there is no satisfactory one to be had (Cohen, 2004; 2009). Regardless,

for my purposes this problem can be completely bypassed. This is because given what I am trying to do in this section, it is sufficient to understand the terms ‘normal observer in normal conditions’ as imposing a set of constraints on the viewing subject and the conditions of observation such that S is normal and in normal conditions iff S complies with constraints $\{c_1, c_2, c_n, c_{n+1}\}$.

Now, the issue is that there does not seem to be any non-circularly specifiable constraints $\{c_1, c_2, c_n, c_{n+1}\}$ such that if a subject viewed a red object, then it would cause an experience as of red in him. Here is an argument: A red object x can fail to appear red to a subject because of a malfunction in his brain (or eyes). So, if x is red is to imply the appropriate non-circular counterfactual, then subjects with a malfunction in relevant areas of their brains must be disallowed by the constraints. The most promising way to do this without circularity is by defining “a relevant malfunction” as a one in any of a set of areas, but it seems that this cannot be done. There are conceivably infinitely many different brains types with different areas relevant to seeing red objects. Thus, for any set of areas, there is an area relevant to seeing red objects not in that set. Even if one could find some constraints that would disallow subjects with malfunctions relevant to seeing veridically, this would just be the beginning. The reason is that there are seemingly endless additional factors that would have to be ruled out.

2. 1. 3: External, appearance dispositionalism

Like with internal appearance dispositionalism so also with the external variant. The only developed species of external, appearance dispositionalism is Noë’s ecological dispositionalism. This is the view that for any color C, C is identical with the disposition

to change the apparent color of any object with the disposition in accordance with the C sensorimotor profile (or color profile). Color profiles just capture the color conditions. Hence, if we substitute color conditions for color profiles, we get that Noe's view is that for any color C that color is identical with the disposition to change the apparent color of any object with the disposition in accordance with the C color conditions. This idea can be captured for red as follows:

Red = the disposition to be

Apparent color¹ in conditions y^1

Apparent color² in conditions y^2

Apparent colorⁿ⁺¹ in conditions y^{n+1}

So, if Noe's view is correct, it follows by the revised SCA that essentially x is red implies that non-circularly, if x were in conditions y^1 , x would be apparent color¹ and mutatis mutandis for all the other apparent colors and their color conditions.

Can the conditions y^1 be specified to ensure without circularity that if x were in them, then x would be apparent color¹? I doubt it. The conditions y^1 includes dependences between object movement and sensory stimulation (object-dependent sensorimotor dependencies) and dependencies between sensory stimulation and bodily movement (Movement-dependent sensorimotor dependences). A malfunction in any areas relevant to seeing red will affect these dependences. Hence, the conditions y^1 must disallow any issues that would result in x not being apparent color¹ in conditions y^1 . The most promising way to do this without circularly defining conditions y^1 is to define "a relevant malfunction" as one to any of a set of areas. However, similarly to what I said in response

to internal dispositionalism, conceivably there are an infinite number of sense organ types with different areas relevant to seeing colored objects. Thus, for any set of areas there is an area relevant to seeing not in that set. If we cannot even get a non-circular account for apparent color¹ in conditions y^1 , then it is hopeless that we could ever get a non-circular account for the disposition Noë says is identical with redness.

2.1.4: Reflectance dispositionalism

Comparable problems also befall reflectance dispositionalism. This dispositional view on color holds that the colors are identical with dispositions to reflect certain proportions of incident light at each wavelength of the visible spectrum. The term ‘Incident light’ is, of course, vague and so needs some clarification. As I said in part 2.2 of this essay, it is possible to qualify ‘incident light’ so that it means ‘normal incident light in normal conditions.’ How should we understand this qualification? There are myriad options available (see part 2.2), but similarly to what I have done above it is sufficient for my present purposes that we understand ‘normal light in normal conditions’ as imposing a set of constraints on the light and the conditions such that L is normal light in normal conditions iff L complies with the restraints $\{c_1, c_2, c_n, c_{n+1}\}$.

If reflectance dispositionalism were correct it would follow by the revised SCA that essentially x is red implies non-circularly, if x were struck with normal light in normal conditions, x would reflect R proportions of light at each wavelength of the visible spectrum. I do not think that any such implication can be specified non-circularly. The reason is that even barring the problem of metamers x is red can fail to imply the mentioned counterfactual because of strange physical laws, circumstances, or both. If

‘normal light in normal conditions’ did not constrain the laws to the actual ones, there would be no hope of x is red non-circularly implying the relevant counterfactual. So, let us say that ‘normal light in normal conditions’ does so restrict the laws. Even so, there is the problem of unusual circumstances.

It seems there are infinitely many physically possible circumstances that could cause x is red not to imply the relevant counterfactual. If this is true, then the only way to specify the relevant counterfactual is to circularly define “normal light in normal conditions.” My argument runs as follows: Imagine a red box designed by advanced aliens that would instantly turn black as soon as it were struck with normal light in normal conditions. The advanced box is red, but it is false that were the box struck by normal light in normal conditions, then it would emit R proportions of light. Thus, in order to ensure that x is red implies the relevant counterfactual ‘normal light in normal conditions’ must be broadened to exclude this advanced box. What about alien rays that would instantly turn x black; what about alien artificial gravity devices that interfere with the R proportions of light reflected by red objects; What about... ?

Obviously, I cannot cover every conceivable interfering circumstances that would cause x is red not to imply non-circularly, if x were struck with normal light in normal conditions, x would emit R proportions of light. Thus, a likely retort is to say that I would eventually run out of interfering circumstances. In response, I ask my opponent to conjure up his inner science-fiction writer and try to imagine interfering circumstances for himself. That is, for any set of constraints on normal light in normal conditions, I ask my opponent to imagine an interfering circumstance not in that set that would cause x is

red not to imply non-circularly, if x were struck with normal light in normal conditions, x would reflect R proportions of light.

2.2: A standoff between intuitions?

One may worry that my argument from the revised SCA is going to lead to a standoff between intuitions. Here is how the worry may go: Let us assume that the friend of dispositional views on color finds some specific disposition she thinks is identical with, for instance, the property red. For example, she may say that the property of being red is identical with the disposition to cause experiences as of red (in us) if viewed by a normal subject in normal conditions, where these constraints are non-circularly defined as those in some set $\{c_1, c_2, c_n, c_{n+1}\}$. I argued above that no matter the non-circularly specifiable constraints it seems that an observer could look at a red object but not have an experience as of red. However, my opponent may say that she rejects this argument with respect to the specific disposition she thinks is identical with redness. With respect to this property, she may claim that given $\{c_1, c_2, c_n, c_{n+1}\}$ it does not seem to her that an observer could look at a red object and not have an experience as of red. I, of course, will deny that it seems this way to me, and so it appears we have a standoff.

My reply is as follows: The vast majority who are sympathetic with dispositional views believe that there must be constraints on the stimulus conditions for the dispositions they think are identical with the colors. The reason for this is that there is a strong, shared intuition amongst the majority of dispositionalists that the stimulus conditions must be constrained. My interlocutor above is no different. So, the only difference between my interlocutor and me is that she insists that given $\{c_1, c_2, c_n, c_{n+1}\}$ it

does not seem to her that a viewer could look at a red object and not have an experience as of red. However, given all the similarities between my interlocutor and me, I think that she must be confused. This is because for the same reasons it seems to her that $\{c_1, c_2, c_n, c_{n+1}\}$ are required, she should agree with me that they are insufficient. In other words, my point is that the same kinds of arguments that were used to show that $\{c_1, c_2, c_n, c_{n+1}\}$ are required could be developed to show that these conditions are insufficient. The equivalent obviously goes for anyone who thinks that there must be constraints on the stimulus conditions relevant to the dispositions said to be identical with the colors.

Conclusion

In section 1 of this chapter, I argued for a revised version of the simple conditional analysis (the revised SCA). In section 2, I argued that the colors are not analyzable by my revised SCA. I first presented the general argument form, and then argued for the premise that the colors only imply counterfactuals circularly specifiable. I did this by showing that the counterfactuals associated with the dispositions that internal, ecological, and reflectance dispositionalism say are identical with the colors can only be specified in a circular fashion. Finally, I examined and rejected a concern about a standoff between intuitions. I believe that in this chapter I have not only succeeded in giving a very plausible analysis of dispositional properties but also succeeded in showing beyond a reasonable doubt that the colors are not dispositions.

Part 3: Categorical views on color

In part 3, I will examine categorical views on color. The revised SCA holds that essentially, x is disposed to M in C iff non-circularly if x were in C , x would M . A property is categorical =df it is not dispositional. Categorical views can either be relational or non-relational, and either reductive, or non-reductive. Cohen's view is a relational and reductive, categorical view; micro-structuralism is a non-relational and reductive, categorical view; and non-relational primitivism is a non-relational and non-reductive, categorical view. In part 3.1, I shall argue against micro-structuralism. In part 3.2, I shall argue against Cohen's view. Finally, I will conclude this part of the essay by arguing for and defending non-relational primitivism in part 3.3.

Part 3.1: Against Micro-structuralism

Micro-structuralism is the view that the colors are identical with micro-structural properties (Smart; 1963, p. 64-87; Armstrong, 1968, p. 270-283; Jackson, 1996). There are three things I accomplish in this chapter. First, I explain the prime motivation for micro-structuralism and its problems (section 1). Second, I present an argument against micro-structuralism similar to the argument from metamers in part 2.2 (section 2). I call it “the problem of multiple causes.” Roughly, the problem is that there are myriad micro-structural properties that are causally sufficient for experiences as of color in most normal observers in normal conditions. Third, I present an argument that I call, ‘the problem of chromatic twin-earth’ (section 3). Roughly, the argument is that color terms refer to the colors, but semantic theories that take color terms to refer to micro-structural properties have unintuitive consequences.

Section I: The prime motivation and its problems

The following has been a prime motivation for micro-structuralism: (1) Colors are causally efficacious (Jackson, 1996, p. 200-201). (2) Only non-relational and reductive, categorical properties can be causally efficacious because of the overdetermination that would arise from causal competition with supervenient properties (Prior et al, 1982, p. 255-256; Kim, 1993a; 1993b; Jackson, 1996, p. 202-203). (3) The only non-relational and reductive, categorical properties with which to reduce the colors are the micro-structural properties of objects. (4). Therefore, the best view on color is micro-structuralism.

1.1: The motivation's problems

I think that the serious problem with this argument is premise (2). There has been a lot of ink spilt motivating overdetermination worries in philosophy. As far as I can tell, whether overdetermination occurs or is really a problem has not been shown. In other words, whether (2) is true is contentious to say the least. In part 3.3, I examine an overdetermination argument against non-relational primitivism that could just as easily be applied to dispositions and other second order properties. I provide and critique responses given by Yablo (1995, p. 486-487) and Watkins (2002, p. 107-137). I also provide my own preferred response. Given my response, I am just not convinced by overdetermination worries and so reject premise (2).

Section 2: The problem of multiple causes

The problem of multiple causes arises from the empirical truth that objects with different micro-structural properties can sufficiently cause the same color experience in most normal observers in normal conditions.⁴³ More specifically, according to Nassau (1983; 1997), there are at least about 15 different features at the micro-structural level that are known by physicists and chemists to sufficiently cause most normal subjects in normal conditions to have an experience as of, for example, an object being sapphire blue. These features comprise the following list: Incandescence, gas excitations, vibrations and rotations, transition metal compounds, charge transfer, metals, pure semiconductors,

⁴³ The opposite of this may be true as well. There is some evidence that objects with the same micro-structural properties can appear different colors to normal observers in normal conditions. For example, it is thought that charge transfer mechanisms like those that cause an experience as of a sapphire stone being blue cause andalusite to appear black or brown.

doped semiconductors, color centers, dispersive refraction, scattering, interference, and diffraction.

Let us look at these micro-structural features in more detail. *Incandescence* is the result of high temperatures causing an object's atoms to emit some of their vibratory energy as photons (or light). *Gas excitations* occur when an atom in a gas or vapor has its electrons excited by incoming radiation. The excited electrons move into higher energy orbits around the nucleus of the atom (representing higher electronic energy levels). Whenever an electron so moves the atom emits a certain quantum of light (or amount of photons). The wavelength of this emitted light is determined by how the electrons move through their orbits. The electronic configuration of the atom together with selection rules determine both what higher orbits electrons move into when excited and how they so move. *Vibrations and rotations* occur when, for example, the atoms of a diatomic molecule oscillate and rotate about their center mass. These rotations and vibrations grant additional energy levels to each electronic energy level.

Transition metal compounds found in crystals like iron, chromium, and copper are one of the best-known sufficient causes of color experience in most normal observers in normal conditions. The atoms of these elements have inner shells (composed of the lowest energy electron levels) that remain partly filled and hold unpaired electrons. The intensity and wavelengths of light given off when the electrons of these compounds become excited typically fall into the visible spectrum. All the excited states of these electrons are defined by their respective atom's electronic configuration, but the position of the excited states is caused by the electric field surrounding the ion. This electric field's shape and strength is caused both by the nature of the surrounding ions and their

arrangement. *Charge transfer* occurs when an electron moves from one transition metal ion to another because of the absorption of light energy.

Being a *metal* is causally sufficient for having a metallic color. Metals have empty electron states at almost all energy levels above a certain point (called the Fermi level). This absence of electron states causes metals to have very high reflexivity and so to have a metallic appearance. In semiconductors there is a gap in the band structure (a property explained by what is called “band theory”) in that the valance band is full but the conduction band empty. Being a *pure semiconductor* can cause one or more different experiences as of color dependent on the size of its band gap. The experiences as of color caused by *Doped semiconductors* have yet another explanation. *Color centers* occur because of the displacement of an electron by irradiation. The location where the electron is displaced from is called a hole center, and the location of the displaced electron is known as the electron center. Both hole centers and electron centers can be sufficient to cause experiences as of color.

Dispersive refraction results from the change in the direction of a wave because of a change in its speed. The most common example of dispersive refraction occurring is the rainbow seen after a storm. *Dispersion* is a physical process by which radiation is forced to diverge from a straight trajectory because of one or more obstructions in the medium through which it is passing. The colors we see during a sunset are caused by dispersion. *Interference* can occur when two beams of light having the same wavelength and trajectory interact with each other creating constructive reinforcement or destructive cancellation. Interference results in the iridescent colors of soap bubbles, oil slicks, and the fur of some animals. *Diffraction* is the result of the way light behaves when it departs

from rectilinear propagation. Diffraction necessarily involves interference but the reverse is not the case. The coronae seen around the sun while dark clouds are passing in front of it are the result of diffraction.

Let us now look at some actual examples of objects with different micro-structural properties that are sufficient to cause the same color experience (in most normal observers in normal conditions). First, butterflies make for good examples. The South American butterfly *Morpho rhetenor*'s looking blue is thought to be sufficiently caused by interference, whereas scattering is thought to be a sufficient cause of the butterfly *Papilio polamedes*' looking blue. Second, there are many examples involving Gemstones. The gemstone sapphire is thought to appear blue because of interference; the gemstone lapis lazuli is thought to appear blue because of vibration energy; the gemstone Maxixe-type beryl is thought to appear blue because of a radiation-induced color center; and the gemstone spinel is thought to appear blue because of a transition metal compound. There are of course other examples.

With the above empirical information at hand, the objection from multiple causes is as follows: Assume that sapphire blue ('sblue' for short) is identical with the micro-structural property M_{sblue} . It is physically possible for two distinct micro-structural properties M_{sblue} and M_{sblue1} to be sufficient to cause experiences as of sapphire blue in most normal observers in normal conditions. The only reason to choose M_{sblue} over M_{garnet} as identical with sapphire blue is that M_{sblue} but not M_{garnet} is sufficient to cause experiences as of sapphire blue in most normal observers in normal conditions. Thus, the micro-structuralist must hold something like the following: For any micro-structural property x , if x sufficiently causes experiences as of color y in most normal observers in

normal conditions, then $x = y$. Call this premise ‘Identity.’⁴⁴ Given Identity, sapphire blue is identical to M_{sblue} as well as M_{sblue1} , for this latter property also causes experiences as of sapphire blue in most normal observers in normal conditions. One thing cannot be identical with two. Thus, we ought to reject the initial assumption. Sapphire blue is not identical with M_{sblue} , and *mutatis mutandis* for the other colors.

The strength of my objection from multiple causes is very similar to the strength of my objection from metamers in part 2.2 of this essay. The strength is that there is no justifiable reason to identify sapphire blue with M_{sblue} over M_{garnet} other than that M_{sblue} but not M_{garnet} is sufficient to cause experiences as of sapphire blue in most normal observers in normal conditions. So, the micro-structuralist must subscribe to something like Identity. However, if the micro-structuralist accepts something like Identity, then he cannot escape the objection from multiple causes. Empirical research has shown us that M_{sblue} as well as M_{sblue1} can sufficiently cause experiences as of sapphire blue in most normal observers in normal conditions. Thus, by the micro-structuralist’s own thinking, he ought to say that M_{sblue1} is identical with the property sapphire blue, as well as M_{sblue} . This is impossible. So, we ought to reject that sapphire blue is identical with M_{sblue} , and *mutatis mutandis* for the other colors.

I can imagine two responses to the argument from multiple causes. The first response is to try to reduce the colors in a domain specific way. The second response is to try to reduce the colors to disjunctive properties similarly to the attempt with reflectance dispositionalism discussed in part 2.2. I shall consider these replies in turn.

⁴⁴ Identity can be thought to be piece of reference fixing or a piece of meaning giving. If it were the former, the issue of whether an object is sapphire blue in a world would depend on whether the object has the micro-structural property responsible for objects looking sapphire blue in the actual world. If it were the latter, the question of whether an object is sapphire blue in a world would depend on whether the object causes experiences as of sapphire blue in that world.

2. 1: Domain specific reductions

A likely reply to the argument from multiple causes is to admit that a general reduction of, for example, sapphire blue to a particular micro-structural property cannot succeed but say that perhaps domain specific reductions of sapphire blue can succeed (Lewis, 1969; Churchland, 1986, p. 356-358; Enc, 1983).⁴⁵ Let me explain this type of response more fully. The idea is analogous to Lewis' (1969) response to Putnam's arguments for multiple realizability. Lewis once said that one could reduce, for example, pain to a chemico-physical property by saying that pain is identical to one chemico-physical property per structure-type. So, one could say that pain is identical with the chemico-physical property C_1 in the domain of humans, C_2 in the domain of fish, C_3 in the domain of birds, and so on. In the case of color one could say, for example, that sapphire blue is identical to having the micro-structural property interference in the domain of sapphire, having vibration energy in the domain of lapis, having a radiation-induced color center in the domain of Maxixe-type beryl, and so on as needed.

In support of domain specific reductions, Patricia Churchland (1986, p. 356-358) and Berent Enç (1983) have explained that such reductions are historically acceptable in the sciences. Consider the example of temperature. Temperature in the domain of gasses is said to be identical with mean molecular kinetic energy. Temperature in the domain of solid objects is thought to be identical with mean maximal molecular kinetic energy. This difference is understood to be due to the fact that object-composing molecules' vibratory motions are reduced by their lattice like structure. Temperature in the domain of plasma is not comparable to temperature in the domain of gasses and solids, because the

⁴⁵ I mention in part 2.2, footnote 41 that domain specific reductions are relevant to the problem of metamers, but explain why I do not discuss them in that chapter.

constituents that compose this substance have been torn apart. If these differences were not enough, empty space can have a temperature according to modern physics even though it contains no molecular constituents.

2.1.1: Identity is a one-to-one relation

An obvious reason why domain specific reductions are bad for our current purposes is that identity is a one-to-one relation but domain-specific reductions require a one-to-many relation in order to answer the question “what are the colors?”. The domain specific reductionist about color is someone who has given up trying to answer questions like “what is sapphire blue?” (perhaps because he thinks that they are unanswerable) in favor of answering questions like “what is sapphire blue in the domain of lapis?”. I have very little grasp on the concept ‘the property of being sapphire blue in the domain of lapis.’ So, it is difficult for me to care about the identity of this property. Regardless, I have not given up on finding an answer to what the colors are, so domain specific reductions have little place in this essay.

2. 2: the disjunctive strategy

The micro-structuralist who accepts the disjunctive strategy says that the colors are identical with disjunctive properties (Smart, 1975). A disjunctive property is, for instance, the property of being P_1 or P_2 or P_3 . Specifically, the disjunctive response in the case of sapphire blue is to say something like that this color is identical to the property of having such and such interference, or such and such vibration energy, or such and such radiation-induced color center, or... The idea behind this strategy is to avoid the problem of

multiple causes by, in a sense, including all the micro-structural properties that cause experiences as of sapphire blue in normal observers in normal conditions within the property to which being sapphire blue is to be reduced.

There are two problems with the disjunctive strategy. The first is that it is probably incompatible with the motivation for micro-structuralism. The second is analogous to the problem that the strategy ran into in part 2.2: The disjunctive strategy fails to address the challenge posed by the problem of multiple causes. I shall look these issues in turn.

2. 2. 1: The strategy's incompatibility

A problem with this strategy, which has been gestured to before (Johnston, 1992, p. 234-236), is that disjunctive properties do not seem any better off when it comes to overdetermination concerns than non-reducible properties or dispositions. The reason for this is that both primitive properties, for example, and disjunctive properties supervene on the micro-physical properties of objects. In fact, things seem worse with disjunctive properties, because there are obvious concerns about how disjunctive properties can contribute unique causal powers over those of their disjuncts. I am not personally that worried about overdetermination (see part 3.3), but the above tension between the disjunctive strategy and the prime motivation for micro-structuralism discussed at the beginning of this chapter is worth noting.

2. 2. 2: *The strategy just does not work*

Regardless of the above concerns, the disjunctive strategy would be ineffectual. This is because my opponent has no reason to assume that there are a finite number of micro-structural properties that are sufficient to cause experiences as of sapphire blue in most normal observers in normal conditions. There is no reason to hold that what is true of M_{sblue} , M_{sblue1} , M_{sblue2} , and M_{sblue3} is not also true of M_{sblue4} . After all, M_{sblue4} can differ from M_{sblue3} by such a small amount that the wavelength proportions of light it reflects are not disparate enough to be detectable by the human eye. Thus, like the reflectance dispositionalist, the micro-structuralist is forced to define the colors circularly in terms of disjunctive properties, the disjuncts of which sufficiently cause experiences of the relevant color in most normal observers in normal conditions. For example, sapphire blue = the disjunctive property x such that x includes all physically possible reflectance properties that sufficiently cause experiences as of sapphire blue in most normal observers under normal conditions. This is the only way the micro-structuralist can ensure that all micro-structural properties that are sufficient to cause experiences as of sapphire blue in most normal observers under normal conditions are disjuncts of the disjunctive property with which they are reducing the property being sapphire blue.

One issue with this strategy is that the disjunctive property x would have to be infinitely large. I doubt that that this is a very plausible view on color. It seems false that the properties we experience in our color experiences have natures that are infinitely large (or complicated). Moreover, as we can never grasp the infinite, this move implies that we can never know exactly what it is that the colors are. This is a problem for a view so poorly motivated as micro-structuralism. Regardless of these problems, defining a

disjunctive property in terms of the color with which it is identical cannot succeed. The worry is that the only reason to believe that the disjunctive property x is identical with sapphire blue and not some other disjunctive property q M_{garnet} or M_{garnet1} or M_{garnet2} or M_{garnet3} is that the micro-structural properties that constitute the disjunctive property x but not the disjunctive property q are sufficient to cause experiences as of sapphire blue in most normal observers in normal conditions. Hence, the micro-structuralist must be implicitly appealing to something like the following variant of Identity: For any disjunctive property x , if x 's disjuncts are sufficient to cause experiences as of color y in most normal observers in normal conditions, then $x = y$.⁴⁶ Call this 'Disjunct-Identity.'

With this premise in mind, please consider the micro-structuralist's assertion. Their claim is that the disjunctive property, for example, x *itself* is identical with sapphire blue. Assume sapphire blue is the color that is sufficient to cause experiences as of sapphire blue in most normal observers in normal conditions. Hence, given the reduction, the disjunctive property x *itself* must be sufficient to cause experiences as of sapphire blue in most normal observers in normal conditions. However, if this is the case, there is a property, namely the disjunctive property x , that is sufficient to cause experiences as of sapphire blue in most normal observers in normal conditions that is not a disjunct of x . So, using this property, we can form a new disjunctive property that is just like x but that it includes x as a disjunct. Call this property, "x-plus." By Disjunct-Identity, it follows that sapphire blue is identical with both the disjunctive property x and with x-plus. This is impossible. So, sapphire blue is not identical with the disjunctive property x and *mutatis mutandis* for the other colors.

⁴⁶ This premise can also be understood as meaning giving or reference fixing. My arguments do not care.

The strength of this argument is that it is not easily defeated for similar to reasons to those discussed in part 2.2. My opponent cannot easily deny that x-plus is a different property from x. Doing so not only commits him to certain views on property identity but also commits him to views on property identity that are in tension with being a realist about disjunctive properties. My opponent also cannot easily claim that he does not subscribe to Disjunct-Identity, but instead to something like what I call “Stern-Disjunct-Identity.” Stern-Disjunct-Identity includes the requirement that the disjuncts of whatever property that is identical with sapphire blue be micro-structural. The reason my opponent cannot make this claim is that there is no principled reason for him to adopt Stern-Disjunct-Identity over its simpler cousin. The micro-structuralist must hold that disjunctive properties are sufficient to cause experiences as of color in most normal observers in normal conditions if he wants the colors to be causally efficacious. So, why hold the requirement that only disjunctions of micro-structural properties are capable of being identical with the colors? The only reason forthcoming is that unless the micro-structuralist accepts this requirement his view cannot succeed, but this is unprincipled.

Section 3: The problem of chromatic twin-earth

The problem of chromatic twin-earth is roughly that color terms refer to the colors but semantic theories that take color terms to refer to micro-structural properties result in unintuitive consequences. This argument requires that I move from ontological concerns to semantic concerns (to a discussion of the meaning of color terms). This move is useful, because colors terms refer to the colors (or at least this is an intuitive assumption on which to base an argument). It follows that the plausibility of micro-structuralism

depends on the plausibility of a semantic theory that takes color terms to refer to micro-structural properties. I will argue that semantic theories that take color terms to refer to micro-structural properties result in unintuitive consequences and, thus, are implausible. Therefore, I will conclude that micro-structuralism is significantly less plausible than is commonly believed by its proponents.

Section 3. 1: The semantic theory

Call semantic theories compatible with Micro-structuralism, “Micro-structuralist semantics” (“MS” for short). MS may be understood as having two primary influences. First, Saul Kripke (1972) and Hilary Putnam (1975) have presented strong arguments in favor of the view that natural kind terms and names are rigid designators, i.e. natural kind terms and names designate the same property (or object) in every possible world. The rigidity of natural kind terms and names allows for two non-synonymous terms (two terms that differ in cognitive significance) to necessarily refer to the same property and thus, for an identity statement containing these terms to be necessarily true even if the two terms are not synonymous. For example, the rigidity of natural kind terms allows for two non-synonymous terms such as “water” and “H₂O” to necessarily refer to the same property H₂O. Hence, the identity ‘water = H₂O’ is true necessarily, despite the terms on either side of the identity operator not being synonymous. The relationship between the two terms in such identity statements may be understood as a relationship between a definiendum and its definiens. Thus, the identity statement ‘water = H₂O’ may be understood as an a posteriori definition of the true essence of water.

Second, so-called “causal” theories of reference for names and natural kind terms have become popular since the late 80s. These causal theories hold that in order for a term to refer to an object, certain causal connections must obtain between the speakers’ use of a term and the object (Boyd, 1988). Causal theories attempt to explain both how a term first comes to refer to a particular object, and how speakers can use the term to refer. For example, if a speaker says “water” while drinking this stuff that happens to be H₂O, then “water” comes to refer to H₂O because of causal mechanisms. Speakers can later use the term “water” to refer to H₂O by standing in appropriate causal relations to the original use of the term.

We are now in a position to understand MS. MS treats color terms as natural kind terms, although it does not commit itself to Boyd’s causal theory of reference in particular. MS merely says that two terms that are not synonymous can be used to refer necessarily to the same micro-structural property.⁴⁷ Moreover, MS should be understood as saying that the relationship between two non-synonymous terms that refer to the same property is analogous to the relationship between a definiendum and its definiens. Thus, for example, according to MS, identity statements such as ‘red = micro-structural property *x*’ should be considered necessary, a posteriori definitions of what redness is.

MS can be formally stated as follows:

MS: Color terms have a posteriori and necessarily true micro-structural definitions such that (1) color terms stand in some type of necessary relation R to certain micro-structural properties (or disjunctions of them) and (2) color terms

⁴⁷ The way I understand this is that a term only necessarily refers once the appropriate relation between the term and the property to which it will refer has occurred. Thus, for example, it is not necessary that “red” refer to physical property *x* simply because of anything to do with the word “red,” but because speakers say “red” when they see this “stuff” that is physical property *x*.

necessarily refer to the micro-structural properties to which they stand in this relation R.

Section 3. 2: The argument against MS

To set the stage for my argument against the plausibility of MS and, thus, micro-structuralism, I must first present a thought experiment. Consider another planet called “chromatic-twin-earth.” Chromatic-twin-earth is exactly like earth except for that fact that the color terms used by its speakers happen to be appropriately R related to different micro-structural properties (or disjunctions of micro-structural properties) from the color terms used by the people of earth. For example, let us say that on twin-earth the word “red” refers to the micro-structural property R_T instead of R_E , “yellow” refers to the micro-structural property Y_T instead of Y_E , and so on for all color terms. *Both objects with R_T and those with R_E look phenomenally red to both the earthlings and twin-earthlings, and both objects with Y_T and those with Y_E look phenomenally yellow to both the earthlings and twin-earthlings, and so on for all “color” properties.* Thus, chromatic-twin-earth is exactly like earth, except that, for example, “red” is appropriately R related to the micro-structural property R_T instead of R_E and so refers to R_T instead of R_E .

With this thought experiment in mind, we can see that the semantic physicalist must claim that the chromatic-twin-earth term, for example, “red” has a necessarily distinct definition from the earth term “red.” To be clear, the semantic physicalist must hold that this disparity in meaning holds because of the following three reasons: (1) The earth and twin-earth color terms refer to distinct properties; (2) according to MS, the definitions of color terms depend on the properties to which they refer, and (3) according

to MS, color terms necessarily refer to the properties to which they refer in the environment in which they are used. Thus, in order for the micro-structuralist semantic theory MS to accommodate the thought experiment, my opponent must hold that, for example, the definition of “red” on earth is necessarily different from the definition of “red” on twin-earth, and so on for all the other color terms.

Hence, as the earth term “red” and twin-color-earth term “red” have necessarily distinct definitions, the semantic physicalist must hold that the two terms also have necessarily distinct meanings. So, according to MS, it also follows that any disagreements about redness (or any color for that matter) between the two groups of humans (the earthlings and twin-earthlings) would only be disagreements about the meaning of the word “red.” Effectively, what is implied by this disparity in meaning is a form of meaning-relativism; what “red” means to earthlings is different than what “red” means to twin-earthlings. This meaning-relativism implies that if the two groups of humans were to come into contact, they would be unable to have any legitimate discussion about the redness of objects, and so on for the other colors.

This inability for the two groups of humans to have any legitimate discussion about the redness of objects is strongly opposed to what seems true in this case. Consider this thought experiment. An earthling and a twin-earthling are in a room together looking at an object with R_E . Unbeknownst to the earthling he has color inverting contact lenses in his eyes, whereas the twin-earthling’s eyes are as they are naturally. The twin-earthling says the object is red, whereas the earthling says that the object is green. According to MS, there is no substantial dispute here about *the color* of the object between the earthling and the twin-earthling, because their color terms have different meanings.

Moreover, MS implies that both the twin-earthling and the earthling are equally wrong, despite the fact that the former is seeing things naturally and the latter seeing things unnaturally due to tampering. These consequences are very odd in my opinion.

Intuitively, the earthling and the twin-earthling are having a substantial debate about the color of the object, and the twin-earthling is right and the earthling wrong.

A likely worry is that MS is compatible with both the earthling and twin-earthling creating some sort of translation manual between earth and twin-earth color terms, and is this not enough? After all, one may think, such a translation manual would allow the parties to have legitimate debate about, for instance, whether an object is earth-red or twin-earth-red. In response to this worry, I do not think that only allowing for legitimate debate about, for example, whether objects are twin-earth-red and earth-red is enough to accommodate our intuitions. A likely concern about my response here runs thusly: Putnam/Kripke style semantics imply similar consequences to the ones I claim are false in the case of MS when used to say that natural kind terms necessarily refer to physico-chemical properties. However, many have accepted the translation manual approach despite these consequences in the case of natural kind terms. So, the translation manual approach in the case of natural kind terms is at least not obviously wrong.

In my opinion there is a significant difference between the colors and natural kinds. The difference is that the colors are phenomenally presented to us in experience whereas natural kinds are not. One is phenomenally presented with the yellowness of gold but certainly not the goldness of gold. It seems that our color terms refer to those properties phenomenally presented to us in our color experiences. That is, “red” refers to *that* property phenomenally presented in experiences of things being red. Ex hypothesi,

earth colors and twin-earth colors look phenomenally the same. Therefore, it certainly seems the earthlings and twin-earthlings must be referring to the same property when they use the word “red.” Unfortunately, the translation manual approach cannot accommodate this conclusion. A corollary of this is that I do not think that colors should be treated the same as natural kinds like water and gold.

Section 3. 3: Discussion

The argument from chromatic-twin-earth gains its strength from the fact that color terms clearly refer to the colors (in ordinary English usage). Thus, if micro-structuralism were true, there would have to be some true semantic theory that allows color terms to refer to micro-structural properties. However, there are few semantic theories from which to choose that satisfy this constraint. The reason is twofold. First, it seems that color terms either have analytically true definitions or definitions that are true a posteriori. The relationship between color terms and physical terms is not analytic. Thus, an analytic semantic theory is incapable of taking the meaning of color terms to be micro-structural properties. Second, it seems that color terms are rigid designators and so must refer necessarily. Thus, the semantic constraint on micro-structuralism puts its proponents in a precarious situation.

My argument has some weaknesses too. I have not shown that micro-structuralism implies MS. So, the micro-structuralist can attempt to avoid my argument against her by providing a semantic theory compatible with Micro-structuralism that does not have the same problems as MS. The only obvious alternative is a variant of MS that allows the meaning of color terms to be something other than the colors even though

color terms refer to the colors. For instance, the micro-structuralist could hold that the semantic values of color terms are Fregean concepts that pick out physical colors in a given environment. I am doubtful, however, as to whether a theory that attempts to separate the meaning of color terms from their referents is plausible in part because of Putnam's argument for the connection of meaning with reference (1975), and in part because it just seems absurd that the meaning of our terms could be independent of their referents.

Moreover, a variant of MS that takes the meaning of color terms to be something other than the colors would imply that what makes human color claims true is different from what makes twin-human claims true, but this has unacceptable consequences in my opinion. Let us call this variant of MS, "VMS." It is not clear what the best version of VMS is, as there are many possible variants of MS that take the meaning of color terms to be something other than the colors. Nevertheless, I take it that VMS must hold (1) that color terms stand in some sort of reference fixing relation R to specific micro-structural properties, and (2) that color terms necessarily refer to the properties to which they stand in this relation. The reason for (1) is that any plausible variant of MS must tell us a story about how the reference of color terms gets fixed, and the reason for (2) is that color terms seem to be rigid designators.

With (1) and (2) in mind, please think back to the chromatic-twin-earth thought experiment discussed in 3.2. Chromatic-twin-earth is exactly like earth but for that fact that the color terms used by its speakers are R related to different micro-structural properties such that on twin-earth the word "red" refers to the micro-structural property R_T instead of R_E , "yellow" refers to the micro-structural property Y_T instead of Y_E , and

so on for all color terms. With this thought experiment in mind, we can see that VMS implies that the chromatic-twin-earth term, for example, “red” necessarily refers to R_T instead of R_E . Hence, according to VMS, what makes earthling claims about red true is necessarily different from what makes twin-earthling claims about red true, and so on for all color terms. Therefore, VMS implies standard relativism about color terms; what is red to earthlings is not red to twin-earthlings.

Unfortunately, this implication of VMS, like that of MS, seems to run contrary to our intuitions. Again, consider the following thought experiment: An earthling and a twin-earthling are in a room and are both looking at an object with R_E . Unbeknownst to the earthling he has color inverting contact lenses in his eyes, whereas the twin-earthling’s eyes are as they are naturally. The twin-earthling says the object is red, whereas the earthling says that the object is green. VMS can allow for substantial debate unlike MS, but still fails to entirely capture our intuitions. Unlike with the natural kinds, it is intuitive that the twin-earthling is right, and the earthling wrong, as the twin-earthling’s visual system is functioning as it naturally would but the earthling’s has been tampered with. However, VMS cannot handle this. VMS can give us the consequence that the earthling is wrong as his eyes have the inverting lenses, but it is unable to give us the consequence that the twin-earthling is right. Hence, although VMS may perhaps work for natural kinds (not saying it does), VMS seems implausible when it comes to the colors.

Conclusion

Micro-structuralism is the view that the colors are identical with micro-structural properties. There are three things I accomplished in this chapter. First, I explained the prime motivation for micro-structuralism and its problems (section 1). Second, I presented an argument against micro-structuralism similar to the argument from metamers (section 2), which I called “the problem of multiple causes.” Roughly, the problem is that there are myriad micro-structural properties that are causally sufficient for experiences as of color in most normal observers in normal conditions. Third, I presented an argument that I called, “the problem of chromatic twin-earth” (section 3). Roughly, the argument is that color terms refer to the colors, but semantic theories that take color terms to refer to micro-structural properties have weird consequences.

Part 3.2: Against Cohen's Relationalism

Cohen's Relationalism (or just "relationalism" for short) is roughly the view that the colors are relational properties like being married or being a sibling (Cohen, 2004; 2006a; 2006b 2007; 2009; 2010). In this chapter, I discuss the plausibility of this view. I have four principal aims: My first is to give a precise formulation of Cohen's view with which to work (section 1); my second is to argue that the color variation argument used to support his view is unconvincing (section 2); my third is to argue that Cohen's response to the objection that his view implies certain absurdities is incompatible with the argument for his view (section 3); and my fourth is to defend the introspective rejoinder that Cohen's relationalism stands in stark contrast to our phenomenally-informed, pre-theoretic intuitions, and so should be rejected (section 4).

Section 1: A precise formulation of relationalism

Relationalism is a metaphysical view on color that has been popularized by Cohen (2004; 2006a; 2006b; 2007; 2009). His view provides an ecumenical response to color variation cases that says everyone is right. Color variation occurs whenever two or more perceptions represent some thing or things as having apparently conflicting colors.

Cohen's relationalism, more specifically, is a view according to which there is a relation R such that for any object x , x is color L iff there exists an observer y (which need not be the same for different x 's) such that x bears R to y (2004; 2009, p. 8-12, 24-36). Cohen provides further details about the relation involved and what the relation holds over.

Cohen suggests that the relation is a three-place relation identifiable by means of color words. For example, in the case of the color red, the relevant relation is a three-place

‘red’ relation. Let us call this relation the “ R_L ” relation. What does R_L hold over? Cohen says that R_L ’s relata must be an external object that bears the color property, a viewing subject, and a viewing circumstance (2004; 2009, p. 9; 24-36; 128-130).

With the above in mind, Cohen’s view on color can be presented as follows:

Cohen’s view: It is constitutive of (or essential to) any color L that there is a three-place relation R_L such that for all x , x has L iff for a viewing subject y_1 and a viewing circumstance y_2 , $R_Lxy_1y_2$ (Section 1.2; Roberts, 2013).⁴⁸

Cohen’s view can be split into two versions that are close to the surface in Cohen’s (2004; 2009) work. Cohen’s view 1 requires condition 1 below for when x bears R_L to y_1 and y_2 , and Cohen’s view 2 requires condition 2 (section 1.2; Roberts, 2013).

1. R_L holds of $\langle x, y_1, y_2 \rangle$ iff y_1 is a viewing subject in circumstance y_2 and y_1 is having a perception as of x being L .
2. R_L holds of $\langle x, y_1, y_2 \rangle$ iff if a viewing subject y_1 in a viewing circumstance y_2 were to view x , then y_1 would have a perception as of x being L .

Cohen’s view 2 better captures Cohen’s relationalism understood as a kind of dispositionalism or role functionalism about color. I however do not understand Cohen’s view to be a dispositional view on color (see Section 1.2; Roberts, 2013). Regardless, I have provided both formulations here, because everything I say below applies to Cohen’s view 1 and 2.

⁴⁸ In part 1.2, I leave viewing circumstances out of the formulation of Cohen’s view, because it is inconsequential to anything in that chapter. It is important that I add it in for this chapter though.

Section 2: The argument from color variation

The following propositions have a strong intuitive pull (Westphal, 1987; Hacker, 1991; Byrne & Hilbert, 2003a):

Incompatibility: No object can be more than one determinable or determinate color all over at the same time. (The term “color” in this proposition refers to those properties in the familiar color solid. Scarlet, jade, aquamarine, sand, etc are determinate colors. Red, orange, yellow, green, etc are determinable colors.)⁴⁹

Realism: External objects are actually colored.

Objectivism: The colors of objects are mind-independent.

However, recently, these intuitive propositions have been questioned by what I call, “the (color) variation argument.” This now prevalent and influential argument presupposes the empirical premise that there is interspecies, intrapersonal, and interpersonal perceptual variation in what colors objects appear to have (“color variation” for short). Color variation occurs whenever two or more perceptions represent some entity or entities as having seemingly conflicting colors. Generally construed, the variation argument can be presented as follows:

P1. There is no reason why one variant is veridical rather than another in X type (a variable to be filled in soon) color variation cases.

⁴⁹ Reddish, yellowish, greenish, etc are super-determinable colors. If the determinate/determinable distinction is best understood as graded, then this can be easily accounted for by adding ‘of the same grade’ to Incompatibility.

P2. The best explanation of P1 is that Incompatibility, Realism, or Incompatibility and Objectivism is false.

3. Therefore, Incompatibility, Realism, or Incompatibility and Objectivism is false (Hardin, 1988; 2004; Mclaughlin, 2003; Cohen, 2004; 2006a; 2007; 2009; Chalmers, 2006; Kalderon, 2007; Mizrahi, 2007; Allen, 2009a).

Cohen (2004; 2009) uses an instance of this argument to support his view. Cohen thinks that the best explanation of P1 is that Incompatibility and Objectivism are false and believes that the denial of these propositions is best captured by his view. Selectionists also use an instance of this argument (or something close) to support their view that visual systems pick out disparate properties to be the colors (Kalderon, 2007; Mizrahi, 2007; see also Allen, 2009a). Many selectionists believe that the best explanation of P1 is that Incompatibility is false and believe that the denial of this proposition is best captured by their view. In addition, color relativists use an instance of this argument to support their view that the colors are relative to perceivers (Brogaard, 2010b; Egan, 2010). Color relativists seem to believe that the best explanation of P1 is that Incompatibility and Objectivism are false, and think that the denial of these propositions is best captured by their view. Finally, Eliminativists use an instance of the variation argument to support their view (Boghossian and Velleman, 1989; Chalmers, 2006; Hardin, 1988; and Maund, 1995). Eliminativists think that the best explanation of P1 is that Realism is false and believe that some version or another of eliminativism best captures the falsity of this proposition.

There are two versions of the variation argument, the metaphysical version and the epistemic one. If we interpret P1 metaphysically, we get the metaphysical version of the argument. If we interpret P1 epistemically, we get the epistemic version of the argument. The metaphysical and epistemic interpretations of P1 respectively are as follows:

M1. There is nothing to make one variant veridical rather than another in *X* type color variation cases.

E1. There is no reason to believe that one variant is veridical rather than another in *X* type color variation cases.

Further, there are generally speaking three instances of both M1 and of E1. The first instance results from filling in *X* with ‘Interspecies.’ Interspecies variation occurs whenever two or more species’ experiences represent that an entity is two or more different colors in the same circumstances. The second instance results from filling in *X* with ‘Intrapersonal.’ Intrapersonal color variation occurs whenever a single subject’s experience represents that an entity is two or more different colors in two or more different circumstances. The third instance results from filling in the variable ‘*X*’ with ‘Interpersonal.’ Interpersonal variation occurs whenever two or more subjects’ experiences represent that an entity is two or more different colors in the same circumstances (lighting is the same etc).

In this section, I provide a comprehensive defense of Incompatibility, Realism, and Objectivism from the variation argument by giving separate responses to the three

most salient versions of its instances.⁵⁰ In section 2.1, I examine a version of the metaphysical, interspecies instance involving typical differences in species' visual systems; in section 2.2, I inspect a version of the metaphysical, intrapersonal instance that involves color contrast effects; and in section 2.3, I examine a version of the metaphysical, interpersonal instance dealing with normal observers. Having discussed the most salient versions, in section 2.4 I scrutinize three versions of the epistemic instance of the variation argument that run parallel to them. Finally, in section 2.5, I briefly give a general response to color variation cases. It is unlikely that my defense of the three propositions will bring my opponents to my side, but I shall have succeeded if I can show them that the arguments considered are ultimately unconvincing.

2.1: A version of the metaphysical, interspecies instance

In this section, I examine a version of the metaphysical, interspecies instance based on the empirical fact that many non-human animals differ from us in how their visual systems are typically constructed. Empirical research shows that the eyes of typical pigeons, goldfish, and ducks, for example, contain four types of retinal receptor (each sensitive to different broadband spectral features). On the other hand, empirical research shows that typical human eyes contain only three types of retinal receptor. Thus, typical pigeons, goldfish, and ducks have what is called 'tetrachromatic vision,' and typical humans have what is called 'trichromatic vision.' As a result of this difference, it takes four appropriately chosen spectral lights (lights that emit certain wavelength proportions)

⁵⁰ Cohen (2009) suggests that the structural similarity between types of variation means we should prefer a uniform response. I do not agree with this. Sure, there is a structural similarity between variation cases, but they are also very different. If one concentrates on the similarities, it may seem that a uniform response is preferable, but as soon as one focuses on the differences this appearance fades away.

for typical pigeons, goldfish, and ducks to perceptually match any given spectral stimulus (an entity that emits or reflects certain wavelength proportions) in standard conditions, whereas it takes three spectral lights for typical humans to perceptually match any given spectral stimulus in standard conditions (Jacobs, 1981; Thompson, 1995, p. 141-160).

With these above facts in mind about animal visual systems, the version of the metaphysical, interspecies instance with which I am concerned is as follows:

$M1^{\text{species}}$. There is nothing to make one variant veridical rather than another in at least some interspecies color variation cases involving typical differences in visual systems in standard conditions.

$M2^{\text{species}}$. The best explanation of $M1^{\text{species}}$ being true is that Incompatibility, Realism, or Incompatibility and Objectivism is false.

3. Therefore, Incompatibility, Realism, or Incompatibility and Objectivism is false.

A popular argument for $M1^{\text{species}}$ rests on the following dilemma: Imagine that there are three spectral lights L that perceptually match a spectral stimulus S for (typical) humans but not for (typical) pigeons (in standard conditions). So, the lights appear the same determinate color to humans but do not appear the same in some respect to the pigeons. Now, ask whether the pigeons or the humans' perceptions of the match are in general veridical. There are four options worth considering. (I) Both the pigeon and humans' perceptions of L are veridical, but only the humans represent color properties. The human represents L as having a color y , and the pigeon represents L as having a color* z (which to be clear is not a color property). (II) The pigeons' perceptions of L veridically represent its color, but the humans' perceptions falsidically represent its color

(or vice versa). (III) Neither the pigeons nor the humans veridically represent the color of L . (IV) Both the pigeon and humans' perceptions of L are veridical, and their experiences both represent color properties. The human represents L as having a color y , and the pigeon represents L as having a color z .

With this dilemma in mind, the argument for $M1^{\text{species}}$ is as follows: (I) is revisionary, because ordinary people as well as philosophers and color scientists have been concerned with the colors that non-human animals perceive. However, if (I) were true, it would turn out that these groups were wrong in their endeavor to understand the colors that non-human animals like pigeons perceive. (II) and (III) are revisionary, because all (or almost all) ordinary people, philosophers, and scientists hold that people and pigeons' experiences are typically veridical. Hence, as options (I)-(III) are problematic, option (IV) is the best one available. Thus, option (IV) must be true. Therefore, $M1^{\text{species}}$ is true (Cohen, 2004, 2006a, 2009, p. 27; see also Kalderon, 2007; Mizrahi, 2007; Allen, 2009a).⁵¹ Call this, "the dilemma argument."

There are two excellent replies to the relevant version of the metaphysical, interspecies instance, depending on how option (IV) of the dilemma argument is interpreted. On the first interpretation, Incompatibility is consistent with both the pigeons and humans' perceptions of L being veridical. Call this "(IV)¹." There are various versions of (IV)¹. Allen (2009a) says that the pigeons and humans' perceptions of L are

⁵¹ Cohen (2009, p. 27) specifically says the following: "Considered by itself, option (i) seems objectionably chauvinistic, while, considered by themselves, (ii) and (iii) seem unduly modest. This is not to say that the chauvinism following upon (i) or the modesty following upon (ii) or (iii) is incoherent, but only that these choices are revisionist with respect to quite a lot of ordinary and scientific talk about color [...]" Cohen (2009) goes on to say (p. 28) that option (I) (option (i) for him) would result in a lot "of what has passed for color ontology and color science [...] [not being] about color after all. [Thus option (i)] would not only revise our taxonomy of fields of enquiry, but also the impression presumably underlying that taxonomy that the properties perceived by pigeons and other non-human organisms are [...] colors."

veridical and represent determinate color properties *of different kinds* in that the colors they represent vary over different dimensions of determination from the three (hue, saturation, and lightness) that our colors vary over. As a consequence of this, the colors that pigeons see are *not* internally related to the colors that we see with respect to these dimensions. Also, because the familiar color solid represents the colors along the relevant dimensions, we can see that the different-kinds view does not locate the colors pigeons see in this solid. I find (IV)¹ under Allen's view to be worrying, because it is conceptually problematic: The analogy would be with a view that says that there are shapes which do not vary over number of sides, length of sides, etc. Allen (2009a, p. 214-219) tries to argue that the conceptual problem is not decisive. Unfortunately, the identifying condition I gave in part 1.1 for the colors is that they are the properties that we actually experience things as having when having visual experiences as of things being colored,' where 'an experience as of a thing being colored' is just an experience with *that* phenomenal character with which we are all familiar. These properties vary over hue, saturation, and lightness. So, Allen's different kinds view is ruled out by the identifying condition by which I defined the enquiry into what the colors are. Regardless, what explains M1^{species} in the pigeon and human case according to Allen's different-kinds view is that the pigeons represent *L* as having colors of a non-human kind that are *compatible* with the determinate colors that the humans represent *L* as having.

If Allen's different-kinds view were the only version of (IV)¹ available, I could see being hesitant about selecting this option regardless of what might be said in its favor. However, there is a more conceptually respectable variant of (IV)¹ from which to choose. This version of (IV)¹ states that pigeons represent more finely grained colors *of the*

human kind than humans and *L* instantiates such properties. For example, perhaps pigeons veridically represent super-determinate colors. Super-determinate colors would stand to the determinate colors the way the determinate colors stand to the determinable ones. Thus, super-determinate colors would vary over the same dimensions of determination as the colors that we see and hence would be internally related to them with respect to hue, saturation, and lightness. So, super-determinate colors are going to be located in the familiar color solid. What explains $M1^{\text{species}}$ in the pigeon and human case given this human-kind view is that the pigeons represent *L* as having super-determinate colors of a human kind that are *compatible* with the determinate colors that the humans represent *L* as having. Regardless of whether this is right, if either the human-kind view or Allen's different-kinds view were correct with respect to the pigeon and human case, one should reply to the relevant version of the metaphysical, interspecies instance by accepting $M1^{\text{species}}$ but rejecting $M2^{\text{species}}$ (and *mutatis mutandis* for other interspecies cases).

I said that the human-kind view is a conceptually more respectable version of (IV)¹ than Allen's. However, there is an argument close to the surface in Allen (2009a) against this view. It is as follows: Assume that Infallibility is true. Infallibility =df if a proposition *p* seems true of the colors after careful reflection (on our experiences as of the colors), then *p* is true of the colors (Johnston, 1992; Byrne and Hilbert, 2007b). After careful reflection, it seems as if the familiar color solid does not allow for the introduction of any novel colors, because the solid spatially represents internal relations of similarity and difference (Westphal, 1987). Call this "Closed." So, from Infallibility, we get that Closed is true. If there are colors that must be introduced to the familiar solid,

then Closed is false. If there are human-kind colors that we cannot perceive, then there are colors that must be introduced to the solid. So, there can be no human-kind colors that we cannot perceive. Thus, pigeons cannot veridically represent super-determinate colors.⁵² (If one is wondering, this argument is only relevant to the human-kind view, because Allen's non-human-kind colors are not to be found in the familiar color solid.)

This argument against the human-kind view requires the premise that if there are human-kind colors that we cannot perceive, there are colors that must be introduced to the familiar solid. Unfortunately, there can be human-kind colors that we cannot perceive that are already in the solid. Thus, for the argument to succeed, it must be shown that we see all the human-kind colors in the solid. I admit that it appears that we see all the determinate and determinable colors of the human-kind. The reason is that it seems the only way there could be determinate or determinable colors of the human-kind that we cannot see would be if they were slotted into the familiar color solid (like pie pieces), but Closed disallows the displacement that would result (Westphal, 1987; Allen, 2009a). However, no such worry arises for human-kind colors that are more finely grained than the ones we see. Super-fine-grained colors would not need to be slotted into the familiar color solid but would just exist underneath (so to speak) the determinate, human-kind colors in the solid like the determinate, human-kind colors are “underneath” the determinables. So, for example, a super-determinate of scarlet would not need to be slotted in next to scarlet like a pie piece but would exist “underneath” scarlet like scarlet is “under” red.

⁵² Allen (2009, p. 205-206) says, “Assuming that the similarity relations are essential to the colors, changing the distances on the hue circle changes the internal relations, and thereby the properties, that the hue circle represents. As such, the extra colors that pigeons perceive cannot be located on our hue circle.”

One may reply that there is evidence that pigeons do not see the same determinable colors that we do (Allen, 2009a). Wright and Cumming (1971), for instance, found that pigeons group wavelengths that fall either side of 540nm and either side of 595nm into separate color categories, whereas humans do not. There are two things I wish to say in response. First, just because some non-human animal or other groups the wavelengths differently from the way humans do does not imply that the animal is seeing things differently. Pigeons, for instance, because of their unique environmental needs, may *just* conceptually divide up the human-kind colors differently. Second, even if the human-kind view were dubious in the pigeon case, the view may be the best fit with regard to some other non-human animal. In light of all the differences between non-human animals (Hardin, 1988; Thompson, 1995) it is unlikely that there is a one size fits all response to interspecies cases. Unfortunately, I cannot in this chapter delve into the relevant empirical data needed to pursue such enquiries. I only wish to show that the human-kind view is a conceptually more respectable way to choose (IV)¹ than Allen's different-kinds view and that the view has not been ruled out a priori.

If (IV) under its first interpretation turned out to be a poor option, (IV) must be interpreted to say that the pigeon and humans' perceptions of *L* are veridical, and that their experiences both represent determinate color properties of the human-kind. Call this "(IV)²." If (IV)² were the best option to the dilemma, then the relevant version of the metaphysical, interspecies instance would succeed. Unfortunately, the dilemma argument gives no convincing reason to think that (IV)² is the best option. What the common man believes who is uneducated in the relevant areas could never have much force in this debate. With regard to what philosophers and scientists think, it is *at best* unclear whether

(IV)² or (I) is the most revisionary. If this is right, then the dilemma argument fails to provide a convincing reason to prefer (IV)² over (I). M1^{species} does not follow from (I), as (I) is not a case of interspecies color variation. (I) implies that pigeons see just colors*, which to be clear are not colors, but M1^{species} is only concerned with interspecies *color* variation cases. Thus, given (IV) understood as (IV)², I reject M1^{species} as not sufficiently motivated in the case of pigeons and humans (and *mutatis mutandis* for versions of (IV) that deal with other interspecies cases). In order to show that it is at best unclear which option is the most revisionary with respect to what philosophers and scientists believe, I will first point out that (IV)² is revisionary to the views of many philosophers. Then, I shall explain why (I) is consistent with scientific research.

It is undeniable that many philosophers, including but not limited to Putnam (1956), Westphal (1987), Hacker (1991), and Byrne & Hilbert (2003a), going back to Wittgenstein's "Remarks on Color," have held, and many continue to hold, that no object can be more than one determinable or determinate color all over at the same time. In other words, many philosophers endorse that Incompatibility is a true proposition about the colors. (IV)² says that the pigeons and humans' perceptions of *L* are veridical, and their experiences both represent determinate color properties of the human kind. So, if (IV)² is true, then Incompatibility must be false. Hence, we can get that (IV)² is revisionary with regard to the views of numerous philosophers.

With regard to (I), I admit that it may be inconsistent with what some of the *sentences* used by scientists mean, especially when simplifying their research for the layman. Nevertheless, Hardin (1988, p. 148) explains that for every scientist who talks uncritically about a particular animal's ability to see the colors, there is another scientist

who issues warnings about making such claims. Hardin goes on to say that scientists become increasingly uneasy with the idea that an animal has color vision as its evolutionary distance from us increases. The reason is twofold. (a) Just because some animals are able to make similar discriminations to humans does not mean that they see colors. (b) Scientists (almost exclusively) rely on behavioral definitions of color vision (Jacobs & Deegan, 1999; Palacios et al., 1990; Wright & Cumming, 1971). For example, although it may seem that Griebel and Peichl (2003) are committed to aquatic mammals having color vision given their title “Color Vision in Aquatic Mammals—Facts and Open Questions,” two pages in the authors *explicitly* say that “[t]he term ‘color vision’ refers to the capability of a visual system to respond differently to light differing in wavelength only” (2003, p. 19). In light of (a) and (b), we can see that (I) (which is that the pigeons and humans’ perceptions of *L* are veridical, but only the humans represent colors) is consistent with scientific research.

I have been arguing in the last few paragraphs that Cohen’s (2004; 2006a; 2009, p. 27) dilemma argument fails to provide a convincing reason to favor (IV)² over (I), because it is at best unclear whether (IV)² or (I) is the most revisionary to what philosophers and scientists think. (Recall that (IV)² is that the pigeons and humans’ perceptions of *L* are veridical, and that their experiences both represent determinate color properties of the human-kind.) At this point, I suspect that my opponent who thinks that (IV)¹ (which is that incompatibility is consistent with both the pigeons and humans’ perceptions of *L* being veridical) must be false is likely to admit that what I say is convincing but suggest that Byrne and Hilbert (2007b) and Allen (2009a) hint at a better

argument for preferring (IV)² over (I).⁵³ The argument is that (IV)² is superior to (I), because this latter option is implausible given all the similarities between human and pigeon visual systems. If it were the case that (IV)¹ must be false and the case that the present argument succeeds, then Incompatibility, Realism, and Objectivism would be in trouble.

I can see how the argument at hand may appear convincing. However, it is ultimately unconvincing because of a serious flaw. The defect is that it presupposes the premise that if a (functioning) visual system *A* is similar in design to a (functioning) color representing visual system *B*, then *A* probably also represents color properties. One cannot make this inference, because doing so would ignore that the differences between *A* and *B* are likely going to have some impact on the properties that they represent. So, to say that *A* represents color properties, one needs to know that the ways in which *A* differs from *B* are irrelevant to whether it represents colors. Alas, with regard to non-human animal visual systems like those of pigeons it is unclear whether this is the case (Thompson, 1995; Hardin, 1988; see also Watkins, 1999; 2002). Hardin (1988, p. 150-152), for instance, makes it explicit that we should not assume that the neurological differences between human and non-humans are irrelevant to seeing the colors. So, at most my opponent can use the premise that if a (functioning) visual system *A* is similar in design to a (functioning) color representing visual system *B*, then *A* probably represents properties at least similar in kind to the colors. However, this premise, unlike the

⁵³ Allen (2009) says, “although comparative ecology is not an exact science, it would not be possible at all if other species did not have perceptual mechanisms that are [...] similar to those found in humans, and it seems incredible to suppose that other species should use these essentially similar perceptual mechanisms to perceive properties that differ fundamentally in kind to the properties that humans perceive.” Byrne and Hilbert’s (2007b) argument is similar. They say, “[option (I)] implausibly supposes that different types of animals use very similar physiological machinery [...] to detect unrelated properties.”

presupposition, fails to support (IV)² over (I), because (I) is compatible with it being the case that pigeons represent colors* that are *similar* in kind to the colors, just not the *same* in kind.⁵⁴

2. 2: A version of the metaphysical, intrapersonal instance

In this section, I examine a version of the metaphysical, intrapersonal instance based on a phenomenon called ‘Color contrast effects.’ Color contrast effects occur roughly whenever an entity that reflects a particular proportion of incident light appears to change color dependent on the particular proportion of incident light reflected by another nearby in time or space entity (or entities). There are simultaneous contrast effects, which involve the space element, and successive contrast effects, which involve the time element (Hardin, 1988). I shall look at simultaneous color contrast effects that occur whenever an entity that reflects a particular proportion of incident light appears to change color to typical observers in typical (daylight) conditions (or something similar) dependent on the particular proportions of incident light reflected by objects in its surround. Here are two examples (Cohen 2004; 2009).

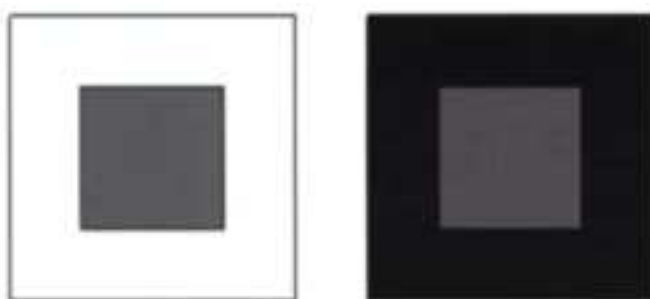


Figure 3.1. Color contrast example 1

⁵⁴ The majority of what I said in this section can be applied mutatis mutandis to variation cases involving differences between humans with typical visual systems and humans with tetrachromatic visual systems. Those concerned with dichromacy may wish to read Byrne and Hilbert’s (2010) article on color blindness.

The above two central squares in figure 3.1 reflect the same proportion of incident light. However, typical observers in typical conditions report that the central squares look different colors depending on what is surrounding the central squares. In this example, typical observers in typical conditions report that the right central square looks lighter than the left central square.

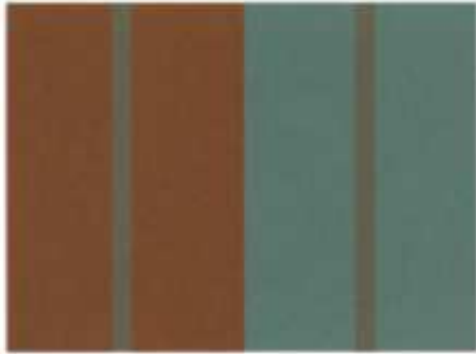


Figure 3.2. color contrast example 2

The above two thin strips in figure 3.2 reflect the same proportion of incident light. Nevertheless, typical observers in typical conditions report that the strips look different colors depending on what is surrounding the strips. In this case, typical observers in typical conditions usually report that the left strip looks lighter than the right one.

Having explained simultaneous color contrast effects, the version of the metaphysical, intrapersonal instance with which I am concerned is as follows:

M1^{intra}. There is nothing to make one variant veridical over another in intrapersonal color variation cases involving simultaneous color contrast effects and typical observers in typical (daylight) conditions (or something similar).

M2^{intra}. The best explanation of M1^{intra} is that Incompatibility, Realism, or Incompatibility and Objectivism is false.

3. Therefore, Incompatibility, Realism, or Incompatibility and Objectivism is false.

An immediate reply to this version of the metaphysical, intrapersonal instance is to say that there is something to make one variant veridical rather than another in (at least most) simultaneous color contrast cases involving typical observers in typical conditions, namely the colors. Hence, it is important to ask, “Why should I believe that $M1^{intra}$ is true?” A very interesting and prevalent argument runs as follows: It is hard to imagine what could make one experience as of the simultaneous color contrast examples had by an typical observer in typical conditions veridical rather than another. Thus, it must be the case that there is nothing to make one experience as of the color contrast examples (had by a typical observer in typical conditions) veridical rather than another. Therefore, $M1^{intra}$ is true (Cohen, 2004, 2006a, 2009; see also Kalderon, 2007; Mizrahi, 2007).⁵⁵ Call this, “the color contrast argument.”

A decent reply is to reject the relevant version of the metaphysical, intrapersonal instance by rejecting the color contrast argument for $M1^{intra}$. One way to do this is to say that it is not difficult to imagine what could make at most one experience as of the color contrast examples veridical. What could make at most one experience as of, for example, one of the central squares veridical is if at most one experience coincided with the actual color of the squares, and *mutatis mutandis* for the other example. A likely retort is to say that this reply is question begging, but to do so confuses the dialectic. The reply is merely trying to defend Incompatibility, Realism, and Objectivism not argue for them. In addition, arguing against this reply by saying, for instance, that being red is like being funny (Cohen, 2006a, note 7) is question begging, because, as Byrne (2006) says,

⁵⁵ Cohen (2009, p. 22) specifically says the following: “[...] it is difficult to imagine a well motivated, principled, and non-question-begging answer. That is to say, it is hard to imagine what, other than stipulation, could make it the case that one of the backgrounds [...] is such that when the stimulus is viewed against that one, it is visually represented as bearing the color that it has.”

whether this analogy holds is the very issue under discussion.⁵⁶ However, as simultaneous color contrast is so salient to the color contrast argument, it would be more convincing to say something specifically relevant to such cases.

Byrne and Hilbert (2003b; 2004) reject $M1^{\text{intra}}$ by saying more along the lines of the above reply. My preferred response to the relevant version of the metaphysical, intrapersonal instance departs significantly from theirs. Instead of rejecting $M1^{\text{intra}}$ roughly my preferred response is to accept $M1^{\text{intra}}$ but reject $M2^{\text{intra}}$, because I think that the colors of objects are dependent on the colors of the surround. I believe that the central squares, the strips, and the relevant parts of all other simultaneous color contrast examples have their respective colors *at least* nomologically dependent on the colors of the surround against which they are placed such that typical perceivers in typical daylight conditions (or something similar) perceive the colors of the examples veridically. Call this “Dependence.” The truth of $M1^{\text{intra}}$ follows from Dependence. However, I do not think that the best explanation of this premise is that Incompatibility, Realism, or Incompatibility and Objectivism is false. This is because I think that what explains $M1^{\text{intra}}$ is that Dependence is true, and this proposition is compatible with Incompatibility, Realism, and Objectivism. So, my preferred response is to accept $M1^{\text{intra}}$ but reject

⁵⁶ Cohen (2006b) has an argument that we should treat colors like humor properties. He argues that (1) we do not make inductions about the causal effects of, for example, red things. But, he says, (2) “if we do not make such inductions about red things, this shows that we are not committed to (indeed, we are doubtful of) the existence of any shared constitutive ground for our inductions about being red” (2006b, p. 434-435). Cohen concludes from this that (3) colors are analogous to humor properties, not objective properties like having a temperature.

I think that it is clear that this is a *separate* argument from the color variation based ones with which I am concerned, because its conclusion that the colors are like humor properties and so subjective in character does not depend on there being color variation cases. So, I will not consider this argument in-depth. Regardless, I believe that it is worth quickly pointing out that the first premise is suspect at best. Here is one inductive inference about the causal effects of colored things: All the black cars I have owned get really hot in the summer; therefore, if I buy this black car it is going to be too hot in the summer. It is not that difficult to think of others.

M2^{intra}. In other words, my preferred response is an Incompatibility, Realism, and Objectivism respecting ecumenical response to simultaneous color contrast cases in which most people are right.

I favor my response over Byrne and Hilbert's, because holding Dependence is the only way to hold onto the seemingly true view that typical observers' color experiences represent the colors veridically in typical daylight conditions (Veridicality) (or something like this) if one holds Incompatibility.⁵⁷ Here is why. First, color contrast effects, unlike shape contrast effects, are *ubiquitous* in our environment (Pervasiveness) (Hardin, 1988; Thompson, 1995; Allen, 2011). I agree with Byrne and Hilbert (2003a; 2003b; 2004) that one ought to distinguish between color and the conditions necessary to perceive color. So, I admit that one can accept that some experiences as of simultaneous color contrast are veridical without accepting Dependence or giving up Incompatibility. Specifically, it is easy to accept that experiences as of related colors like brown, which can only be seen as a consequence of contrast, are usually seen veridically. However, clearly only a minority of cases can be accounted for in this way. Thus, if Dependence is false, then either Veridicality is false or Incompatibility is false.

Second, Incompatibility is true. Third, Veridicality is true. A likely worry about Veridicality is that the empirical data appears to suggest its falsity. However, Allen (2010b) and Roberts and Schmidtke (2012) have shown that this appearance is probably just that. Roberts and Schmidtke show that a lot of the disagreement suggested by the

⁵⁷ Veridicality presupposes that the word 'scarlet' refers to the property scarlet and only the property scarlet assuming it refers at all, and so on for the other colors. This rules out, for example, there being real scarlet and apparent scarlet in Noë's sense (2004, p. 143-144). There is only one property of being scarlet. This in turn rules out trying to hold Veridicality and Incompatibility without holding Dependence by saying that in color contrast cases we see the apparent colors of objects veridically: If the real colors are *the* colors, then the apparent colors are irrelevant to Veridicality; if the apparent colors are *the* colors, one ends up with Dependence after all.

empirical data is explained by *conceptual* factors relevant to the tasks used, and so the data falls short of showing the mass *perceptual* disagreement necessary to undermine Veridicality. The factors Allen points out are too numerous to list here. However, one of my favorites is that unique green tends to shift towards shorter wavelengths with age, because the crystalline lens in the eye becomes more opaque over time. Hence, if we exclude the elderly, who make up a minority (about 12% are over 60), from the population statistics, we can see that there is less disagreement amongst people than it would otherwise seem. In light of these articles, it appears that the empirical data is consistent with Veridicality. The data certainly does not support the vast degree of perceptual disagreement that would be the case given Pervasiveness were Incompatibility true and Dependence false. Accepting the three propositions Pervasiveness, Incompatibility, and Veridicality (or something close to it), the truth of Dependence follows.

Having provided a reason to hold Dependence, I will now look at the proposition in some depth. I defined Dependence broadly, because I desire to remain neutral about whether the colors of objects nomologically or metaphysically depend on the colors of the surround. Regardless, there are some things that can be clarified. Dependence implies that an object's color neither supervenes in a strong nor a weak sense on its intrinsic micro-physical properties but is compatible with the colors more globally supervening on these properties. Is Dependence compatible with the colors being physical properties? The answer to this question is "yes" at least under supervenience physicalism (Jackson, 1993; Chalmers, 1996). Does dependence imply that the colors are relational properties? The answer to this question is clearly "no" with respect to the weaker, nomological

version of Dependence. The answer is also “no” with respect to the stronger, metaphysical version. In order to see why one need only examine my improved analysis of relational properties (part 1.2).

Improved analysis: A property P is relational iff there is some relation R such that it is essential to P that for all x , if x has P, then for some thing(s) $y_1...y_n$, $Rxy_1...y_n$.

It follows from the metaphysical version of Dependence that there is some relation R such that for all x , if x is, for example, red, then for some thing(s) $y_1...y_n$, $Rxy_1...y_n$.

However, this is insufficient given the analysis to show that redness is a relational property. The analysis requires that it be essential to redness that if x is red, then for some thing(s) $y_1...y_n$, $Rxy_1...y_n$. In fact, it is a priori that redness does not meet the improved analysis. So, not only does Dependence not imply that the colors are relational but also given the improved analysis I developed in part 1.2 one, can see that redness is not a relational property and the same goes for all the colors.

At this juncture, I shall address some concerns. First, I realize that my response to the version of the metaphysical, intrapersonal instance being considered may be unpopular. The main reason is this. (a) My response depends on the central squares in example one, the strips in example two, and the relevant parts of all other simultaneous color contrast examples having their respective colors dependent on the colors of the surround. However, it is often implicitly held (b) that the colors are independent of surround, and (c) that the color contrast effects would remain even if the central squares and the strips were causally isolated from the surround. Thus, what is often implicitly believed seems to rule out parts of color contrast examples having their respective colors dependent on the colors of the surround.

In order to respond to the concern about (b) I must differentiate between two propositions. The first, call it “Weak-Independence,” is that the *determinable* colors are *mostly* independent of the surround, and the second, call it “Strong-Independence,” is that the determinable and *determinate* colors are *always* independent of the surround. Color contrast effects seldom cause an object to appear a different determinable color (although this happens occasionally as one can see from example two above). So, with this distinction in hand, it is clear that Dependence is compatible with Weak-Independence. Hence, Dependence implies a falsity only if Strong-Independence is true. Why believe Strong-Independence over Weak-Independence? My opponent may say that the reason is that our intuitions favor Strong-Independence over Weak-Independence. In reply, I admit that we should not deny that the colors are to some degree independent of surround. However, I find it difficult to see why we should trust any intuitions that favor Strong-Independence over Weak-Independence. In fact, there is a very good reason not to. Because color contrast effects rarely cause an object to appear a different determinable color, it is easy not to notice them even though they are ubiquitous in our environment. This is why Hardin (1988), amongst others, had to bring the pervasiveness of color contrast to the attention of philosophers. Thus, it would hardly be surprising for our intuitions to favor Strong-Independence even though it is Weak-Independence that is really true.

The reason people believe (c) is that if one were to look at, for example, the central squares through a reduction scope, the color contrast effects would no longer be visible. This is a poor reason to believe (c). Plausibly using a reduction scope would result in falsidical perceptions of the central squares. This is because it is suspicious that

blocking out the light emitted by the objects that surround the central squares would put us in a position to veridically represent the squares' colors. The analogy is with size where we know that restricting the background information coming into our eyes can result in illusions. The Ames room is a good example of this (Gibson, 1979, p. 281; Runeson, 1988, p. 296). If reduction scopes result in falsidical perceptions, then such scopes cannot be used to rule out the possibility that the colors of the central squares are causally dependent on the colors of their surrounding objects and *mutatis mutandis* for parts of all other simultaneous color contrast effects.

A second concern is that that ordinary practice for determining an object's real color in contrast cases is to remove it from its surround. In reply, I admit that some examples suggest that ordinary practice is to treat color contrast effects as if they result in illusions (Tye, 2000, p. 155). For example, I confess that if one bought yellow paint for a highlight wall in a room in which the other walls were green, one would not return the paint claiming that the wall changed the paint's color. However, there are other examples in which it would seem that people do not treat color contrast effects like they result in illusions. For example, most would describe the colors of an artwork (e.g. a Piet Mondrian) as if they are really there and not an illusion brought about by color contrast effects. In fact, people often talk about using color contrast *to make* a color more vibrant, brighter, or darker, not just to make it *appear* in those ways. Thus, looking at what people do does not allow one to arrive an unambiguous ordinary practice.

A third worry is that once one accepts Dependence one is on a slippery slope to being forced to hold that the colors of objects depend on lighting conditions. However, this slope is not as steep as it appears. Because of the phenomenon of color constancy, the

argument I gave for Dependence cannot straightforwardly be exploited to show that the colors of objects depend on lighting: One is not committed to saying that if the colors of objects are independent of lighting, then either Veridicality is false or Incompatibility is false, because in typical daylight conditions the colors of objects appear to remain constant through changes in illumination. It is true that even in typical daylight conditions shadows influence how an object appears. The natural account though is not that a, for example, red object half covered in shadow appears to have different colors. Rather, the natural account is that the object appears to be red and half covered in shadow. Phenomenologically, it is as if the shadow is on the object obstructing our view of its color. Even in cases involving “bad” lighting, it is usually the case that the colors of objects do not appear to change. When a concentrated, blue beam of light shines on a white wall, we do not experience the wall as having a blue part but the wall as having blue light on it. Phenomenologically, it is as if the blue light is on the wall obstructing our view of its color. Likewise, the absence of light seems to *just* conceal the colors.

A fourth concern is that there are some color contrast cases for which Dependence seems ill equipped to provide the ecumenical response for which it was intended. The worrying cases are ones in which an object appears one color when viewed from a perspective in which a particular surround is visible and then another color when viewed from a perspective in which another is. One cannot say that the object is both colors all over at once without denying Incompatibility, and one cannot say that it changes colors dependent on one’s perspective without denying Objectivism. Regardless, the relevant cases can be easily addressed. Physical objects are highly complex, as can be seen when looking through a microscope, and so cannot be seen in their entirety from any one

perspective. Thus, the friend of Dependence can preserve the desired ecumenical response by holding the plausible thesis that when viewing an object from different perspectives one is always seeing (at least slightly) different parts of the object. Given this thesis, one can say that an object really does have both the colors it appears to when viewed from one perspective and then another; but it is never the case that it has both colors *all over* at once, and it is never the case that its colors change mind-dependently.

One may retort that it does not appear that one is seeing different parts when one only makes minor alterations in perspective, but it is unobvious that this is true. Even a simple wall has a complex texture that can be seen. If one changes perspective just a little, does it not appear that one is seeing different features or parts of this texture? Proponents of Dependence would not need to give up much even if this question must be answered in the negative. They can still use Dependence to provide an ecumenical response to the majority of color contrast cases. In fact, perhaps they would not need to give up anything. They can say that the content of experience never includes particular surfaces of objects. Rather, the content is always that there is a surface(s) that is F (at such and such a distance away). If proponents of Dependence were to accept such an existential view on the contents of perception, they could provide an ecumenical account for the cases being considered. Experience 1 represents that there is a surface(s) that is red, and experience 2 represents that there is a surface(s) that is green, and, because of Dependence, the object has a surface(s) that is red and a surface(s) that is green. Whether an existential view of the contents of perception is correct is the subject of a heated debate (McGinn, 1982; Campbell, 2002) that cannot be discussed here. Regardless, it should be clear that the relevant cases are not sufficient to show that Dependence is false.

A final likely concern is that my argument for Dependence is question begging, because it relies on Incompatibility and Realism. However, this concern is a result of confusing the dialectic. So far, I have said that the relevant version of the metaphysical, intrapersonal instance is flawed at $M2^{\text{intra}}$, because what explains $M1^{\text{intra}}$ is that Dependence is true. So, in order to defend the relevant version of the metaphysical, intrapersonal instance, my opponent must argue that those who accept Incompatibility, Realism, and Objectivism cannot justifiably explain $M1^{\text{intra}}$ using Dependence. One does not have to assume that Realism and Incompatibility are false when defending them from their opponents. So, I am free to use these propositions to argue for Dependence. Hence, for my opponent to reject my explanation of $M1^{\text{intra}}$ by denying Dependence, he must at the very least undercut my argument for Dependence without just assuming the falsity of Incompatibility or Realism (or both).

My opponent may try to do this by providing an independent argument for the falsity of Incompatibility or Realism (or both). Whether such an argument succeeds is beside the point, as this article is focused on color variation arguments. Above I provided a defense of Veridicality (or something close enough to it) by appealing to Allen (2010b), and Roberts and Schmidtke (2012), but my opponent may wish to push me on the truth of this proposition. Clearly, any attempt to do this by providing an independent argument for the falsity of Incompatibility or Realism (or both) is beside the point given the scope of this article. Moreover, arguing against Veridicality (or something like it) is not open to selectionists and relationalists who hold that something similar to this proposition is

true.⁵⁸ Finally, whatever one may think of Veridicality, the dialectical force of what I have said should not be underestimated.

2. 3: A version of the metaphysical, interpersonal instance

In this section, I inspect a version of the metaphysical, interpersonal instance based on the claim that there is interpersonal variation in color perception amongst normal observers. Imagine two people, John and Jane, who are both normal observers, according to the Ishihara or Farnsworth color blindness tests, and in identical conditions. As I said, I am not convinced in light of Allen (2010b), and Roberts and Schmidtke (2012) that there is anywhere near as much perceptual disagreement about the colors as the empirical literature appears to suggest. Nevertheless, empirical research seems to suggest that the following type of variation often occurs: John and Jane are both viewing, for example, Munsell chip 527, which is just a chip painted blue₅₂₇. However, whereas the chip looks blue without a tinge of any other color to John (unique blue), it looks blue with a tinge of green to Jane (Tye, 2006).

Having elucidated this type of variation, the version of the metaphysical, interpersonal instance with which I am concerned can be stated as follows:

M1^{inter}. There is nothing to make one variant veridical rather than another in interpersonal color variation cases involving normal observers in identical conditions.

M2^{inter}. The best explanation of M1^{inter} is that Incompatibility, Realism, or Incompatibility and Objectivism is false.

⁵⁸ An eliminativist may worry that evolution poses a threat to Veridicality (Chalmers, 2006). I refer my reader to Byrne and Hilbert (2007b) who have a thorough reply.

3. Therefore, Incompatibility, Realism, or Incompatibility and Objectivism is false.

I believe that $M1^{inter}$ is false, because it seems to me that at least on occasion there is something to make one variant veridical rather than another in interpersonal color variation cases involving normal observers (in identical conditions), namely the colors. Thus, I must ask, “Why should I believe that $M1^{inter}$ is true?” A very popular and intriguing argument runs as follows: It is difficult to imagine (or as some philosophers say arbitrary, unjustifiable, or implausible) what could make it true that John or Jane but not both veridically represents the chip’s color (call this, “Either”), *given* that they are both normal observers (Cohen, 2004; 2006a; 2009; Chalmers, 2006; Cohen, Hardin & McLaughlin, 2006; Kalderon, 2007; see also Hardin, 1988; 2004; McLaughlin, 2003; Mizrahi, 2007). Thus, there must be nothing to make John’s perception veridical over Jane’s (and vice versa) in this case.⁵⁹ Therefore, $M1^{inter}$ is true. In other words, the problem is that my opponents cannot imagine an answer to how it is possible (or think that it is arbitrary, unjustifiable, or implausible) that Either is true, *given* that John and Jane are normal observers. Call this, “the normality argument.”

Byrne and Hilbert’s favored response to the normality argument for $M1^{inter}$, similarly to the reply they endorse against the color contrast argument, is to say that it is

⁵⁹ Let us look at three examples of this argument. First, Cohen (2006a, p. 310) when motivating his argument from perceptual variation says the following: “When two *normal* trichromatic observers [emphasis mine] view ship *C* under identical perceptual conditions, *C* looks unique green to one of them but bluish green [...] to the other.” Then, Cohen goes on to say that the problem with this situation is that “it is extremely hard to imagine what could (metaphysically) make it the case that [Either is true]. Second, Chalmers (2006, chapter 6) says that accepting Either is problematic, because “it imposes an asymmetry on what otherwise seems to be a quite symmetrical situation.” He says the problem with this is that both subjects’ [John and Jane in our case] perceptual mechanisms are functioning in a way that is *normal* [emphasis mine] for [their] communities.” Third, Kalderon (2007, p. 566) says, “Since Norm and Norma [John and Jane for us] are normal perceivers, it is arbitrary to suppose that one and not the other is misperceiving the color of the chip.” There are many other examples.

not difficult to imagine what could make Either true (2003a; 2003b; 2004; 2007b).

Rather, as they say, what could make Either true is if the chip were either, but not both, unique blue or blue tinged with green. My opponent may say that this reply is question begging, but to say this, just like it was earlier, would be to confuse the dialectic. Byrne and Hilbert are just defending Incompatibility, Realism, and Objectivism not arguing for them. The argument via analogy with the property being funny also works no better here than it did before. However, there is room for more to be said, because the normality argument is that it is difficult to imagine what could make Either true, *given* that (or because) John and Jane are normal observers. Thus, it would be preferable to respond to the argument by saying something about John and Jane being normal.

Unlike with the color contrast argument, I basically agree with Byrne and Hilbert's response to the normality argument, but as I mentioned, there is room for more to be said about John and Jane being normal. What explains the possibility of Either, given that John and Jane are normal observers? The answer is that the scientists who designed the Ishihara and Farnsworth tests were only concerned with discerning those who would have difficulties completing certain tasks, not with veridicality (Japanese Ophthalmological Society, 2003; The American Society For Nondestructive Testing, 2003). Byrne and Hilbert (2007a) mention normality but assume that the notion of normality that the Ishihara and Farnsworth tests were designed to measure is statistical. However, the Ishihara and Farnsworth exams were designed for the Japanese and US military respectively, and these organizations would have been principally concerned with ensuring that recruits could adequately perform their duties, not with whether they have (statistically) average color vision. This is because it could have turned out that

merely average vision is insufficient to perform the relevant tasks or that it is more than enough. Therefore, the notion the tests were designed to measure is going to be functional rather than statistical.

Improving on Byrne and Hilbert's favored reply, I have dismantled the normality argument for $M1^{\text{inter}}$ by demystifying how there can be interpersonal variation despite normality (according to the Ishihara and Farnsworth exams). So, although the normality argument has been popular and persuasive, it is ultimately unconvincing. I now want to make a broader point that any variant of the normality argument that appeals to the results of exams for normality is bound to fail. Tests for normality could either be designed with the purpose of distinguishing veridical perceivers or not. It would only make sense to design tests to distinguish veridical perceivers if there could be real perceptual disagreement. So, if the tests were designed to distinguish veridical perceivers, then the scientists who designed them would have decided what makes it true that we perceive veridically and in what conditions we do so. Assume scientists say that being blue is identical with reflectance type R_B , and that blue objects are veridically perceived in natural daylight. People who passed tests with such assumptions would agree that objects with R_B look blue when viewed in natural daylight. Thus, no form of the normality argument could appeal to the results of such tests and *mutatis mutandis* for all similar tests.

If the tests were not designed to distinguish veridical perceivers, then there could be nothing puzzling about people who passed the tests perceptually disagreeing about the color of some stimulus. Assume scientists design the tests to distinguish people who can operate certain equipment, as they did with the Ishihara and Farnsworth exams. Anyone

who passed a test with such a purpose would be able to operate the relevant equipment, but it should be unsurprising if it is later discovered that those who passed disagree about what looks blue. If there is nothing odd about people who pass tests with such a purpose perceptually disagreeing, then it should be easy to imagine what could make one but not the other's experience veridical and *mutatis mutandis* for all similar tests. Thus, either way you go, any form of the normality argument for $M1^{\text{inter}}$ that appeals to the results of tests cannot succeed.

2. 4: The epistemic, variation argument

I now want to briefly turn to the epistemic interpretation of the variation argument (“the epistemic argument” for short), because this interesting argument is close to the surface in Cohen (2004; 2009) and Mizrahi (2007). The argument is as follows:

E1. There is no reason to believe that one variant is veridical over another in X type color variation cases.

E2. The best explanation of E1 is that Incompatibility, Realism, or Incompatibility and Objectivism is false.

3. Therefore, Incompatibility, Realism, or Incompatibility and Objectivism is false.⁶⁰

There are three general instances of E1 ($E1^{\text{species}}$, $E1^{\text{intra}}$, and $E1^{\text{inter}}$) depending on whether one fills in X with “interspecies,” “intrapersonal,” or “interpersonal” respectively. Thus, there are three general instances of the epistemic argument (the interspecies,

⁶⁰ Consider, for example, the fact that the second premise of Cohen's (2004, 2009, p. 24) master argument for relationalism is that “there is no independent and well-motivated reason *for thinking* [emphasis mine] that just one of the variants [...] is veridical [...].” For another example, consider that Mizrahi (2007, p. 290) says, “the problem [...] is that there is no [...] knowable standard” by which to determine that one variant is veridical over another.

intrapersonal, and interpersonal instances). For the purposes of this chapter, the versions of these three instances with which I wish to concentrate parallel those focused on in the above sections.

Given my previous responses to the relevant versions of the metaphysical, interspecies, intrapersonal and interpersonal instances (in subsections 2.1, 2.2, and 2.3 respectively), it is justifiable to deny the relevant instances of E2 for every instance E1. Based on what I said in subsection 1, either the relevant interspecies cases are not examples of color variation or the best explanation of E1^{species} is that such cases are ones in which animals see super-fine-grained colors that are compatible (according to Incompatibility) with the colors we see. With regard to what I said in subsection 2, what explains E1^{intra} is that the colors of objects are dependent on the colors of the surround such that typical observers in typical conditions represent simultaneous color contrast examples veridically. Given what I said in subsection 2.3, what explains E1^{inter} is that the tests that, for example, John and Jane passed (the Ishihara and Farnsworth exams) were only designed to discern perceivers who would have difficulties performing certain tasks.

A likely reply is that what I said about John and Jane suggests that it is impossible to know who perceives veridically in interpersonal cases involving normal observers, but this is problematic for Incompatibility and Realism. The argument may run as follows: It is unreasonable to postulate a property if it is impossible to verify (for premises like this see Cohen, 2004; 2009; Triplett, 2007; see also Hardin, 1988; 2003).⁶¹ The interpersonal

⁶¹ Cohen (2009, p. 33) says, “It is reasonable to think that, in the absence of a non-stipulative criterion that makes one of the variants under consideration veridical at the expense of the others, it is preferable to treat the variants uniformly.” Triplett (2007, p. 168) says when speaking of color variation cases that “it is unreasonable to posit the existence of a physical object or property if it cannot, in principle, be intersubjectively verified.” In addition to these examples, Byrne and Hilbert (2007a) say that verificationism is close to the surface in Hardin (1988; 2003).

case of John and Jane in subsection 2.3 is one in which we cannot verify using the Ishihara and Farnsworth tests who perceives the Munsell chip's color veridically if we accept Incompatibility. Moreover, Cohen (2009, p. 32) points out that neither looking at what the majority sees nor using the CIE 1931 standard observer specification would allow us to determine whether John or Jane is the veridical observer. Thus, as the argument goes, this interpersonal color variation case shows that either we ought to reject Realism or we should give up on Incompatibility.

The response being considered has some dialectic force if the 'cannot' is understood as logical impossibility. There is certainly something wrong with postulating a property the verification of which is logically impossible. For example, there is something objectionable about postulating angels that by their very nature avoid all attempts at verification in order to explain gravity. John and Jane like variation cases, however, at most imply that it is *practically* impossible to verify who perceives veridically, because our current inability or even a repeated failure (Cohen, 2006a, p. 313) to do something does not even imply that it is physically impossible to do that thing. Hence, although it may be difficult to imagine how to verify whether John or Jane is right, no reason has been given for thinking that it cannot be done. There is certainly nothing in the nature of the colors that logically precludes verifying whether John or Jane is right. Thus, at the very most what can be said is that we do not know how to verify whether John or Jane is right and as far as we can tell there are going to be practical issues with doing so, but this is no reason to give up on either Realism or Incompatibility.

2. 5: A general response to color variation cases

I have focused on salient versions of interspecies, intrapersonal, and interpersonal color variation cases: In subsection 2.1, I responded to interspecies color variation cases due to typical differences in visual systems in standard conditions; in subsection 2.2, I responded to simultaneous color contrast effects involving typical observers in typical conditions; and in subsection 2.3, I responded to interpersonal color variation cases involving normal observers in identical conditions. Then in subsection 2.4, I said that the three instances of the epistemic argument with which I am concerned parallel those described in the above sections. Regrettably, as I restricted the type of cases to which I have so far provided responses, my opponents are likely to be worried about other color variation cases relevant to the truth of Incompatibility, Realism, and Objectivism.

It is impossible to provide a response to every conceivable color variation case, but I can provide a rough strategy for dealing with any color variation based argument. Recall that M1 says that there is nothing to make one variant veridical rather than another in *X* type color variation cases. So, the strategy is that for every iteration of this premise one should say that one of four possibilities is going to be true: (1) M1 is irrelevant, because the variants are not seeing colors; (2) M1 is true, but the best explanation of this is that something is causing either both variants to be falsidical or both to be veridical that is compatible with Incompatibility, Realism, and Objectivism (applies to M1^{intra}); (3) M1 is false, because there are color properties to make one variant veridical rather than another; or (4) M1 is too abstract but once made more concrete either (1), (2), or (3) will be true (applies to M1^{inter} and M1^{species}). One can then use the response given to any version of the metaphysical, variation argument to aid a response to the parallel version

of the epistemic argument. Given the strategy described above, my opponent's concern about other color variation cases should be somewhat abated: I have shown that there is no reason to think that there is a version of the color variation argument that succeeds, and this is all I needed to do in order to defend Incompatibility, Realism, and Objectivism.

Summary of section 2

Cohen uses the color variation argument to reject Incompatibility and Objectivism and believes that that his view best captures the denial of these two propositions.

Selectionists, relativists, and eliminativists also use the color variation argument to support their views. I have shown that although color variation based arguments against Incompatibility, Realism, and Objectivism have been popular they are *ultimately* unconvincing. Thus, I have shown that Cohen's attempt to motivate his view is unconvincing. As a corollary, I have shown that the variation argument fails to motivate selectionism, relativism, and eliminativism as well.

Section 3: Color incompatibility and ordinary illusion

Cohen's view gives a uniform response to color variation cases according to which everyone is right. This allows the proponent of Cohen's view to avoid what he considers to be ad hoc stipulation in variation cases; he can say that everyone is right and so need not say that one variant is veridical at the expense of another. However, because Cohen's view gives a response according to which everyone is right, it has the unintuitive consequence that the following propositions are false:

Incompatibility: No object can be more than one determinate or determinable color all over at the same time. (Examples of determinate colors are scarlet, jade, aquamarine, and sand. Examples of determinable colors are red, orange, yellow, and green. Reddish, yellowish, greenish, etc are super-determinable colors and so are not relevant to Incompatibility as defined. If the determinate/determinable division should be understood as graded in nature, then this can be easily accommodated by adding ‘of the same grade’ to the above statement of Incompatibility.)

Illusion: Ordinary illusion cases occur whenever the color we perceptually represent conflicts according to Incompatibility with the object’s real color. (The use of ‘ordinary’ in the definition of Illusion rules out illusion cases due to deviant causal chains like the case involving Cohen’s telekinetic tomato, 2007, p. 341. So, according to Illusion, an ordinary illusion occurs, for example, if x is red and S perceptually represents it as being blue and S’s representation is not the result of deviant causal chains.)

Incompatibility and Illusion are extremely intuitive. Incompatibility is cited alongside mathematical truths like $2+2=4$ as a quintessential example of a synthetic a priori certainty. Illusion is intuitive, for it is biconditionally associated with the following intuitive proposition:

P-Incompatibility: The colors we perceive obey Incompatibility.

Thus, in addition to implying the falsity of Incompatibility and Illusion, Cohen's view also implies that P-Incompatibility is false. Perhaps all these intuitions are in fact false, but this is highly implausible. So, it would be best if Cohen's view could accommodate them.

Cohen certainly seems to agree. Cohen (2009; 2007) differentiates between hallucinations, illusions due to deviant causal chains, and ordinary illusions. Of these three kinds of perceptual error, only ordinary illusions are relevant to this section. Cohen claims to provide a "relationalist treatment" of ordinary perceptual illusion (2009, p. 122-132; 2007, p. 342-345). Under a plausible interpretation of what is going on, this 'treatment' is not an attempt to explain away the intuition that Illusion is true, rather it is an attempt to (more or less) accommodate the intuition. Illusion is true iff P-Incompatibility is true, and clearly if P-Incompatibility is true, then Incompatibility is true. So, to whatever degree Cohen can accommodate Illusion with his treatment he can also accommodate Incompatibility and P-Incompatibility.

The purpose of this section is to investigate whether Cohen's "relationalist treatment" can succeed. Ultimately, I plan to show that Cohen's treatment is in serious tension with the motivation for his view. In section 3.1, I focus on distilling Cohen's treatment and defending my interpretation. In section 3.2, I argue that Cohen's treatment, as I distilled it, is in tension with his argument from perceptual variation, and that his response regardless of interpretation is in serious tension with his basic arguments for the first premise of his argument from perceptual variation. Finally, in section 3.3, I look at whether there is a way for Cohen to avoid my criticisms. Specifically, I look at whether the basic arguments can be modified to avoid said tensions and at an attempt to explain

away our intuitions. Although I doubt that I will convince Cohen that his view is implausible, I will rest content if I can show him (and his proponents) that the considered “relationalist treatment” cannot work.

3.1: Cohen’s relationalist treatment

What follows is my distillation of Cohen’s treatment of ordinary perceptual illusion. Under my interpretation, Cohen (2009, p. 122-132; 2007, p. 342-345) attempts to accommodate Illusion by distinguishing between fine-grained and coarse-grained relational color properties L that invoke different versions of the condition on when R_L holds of $\langle x, y_1, y_2 \rangle$.⁶² With respect to fine-grained properties, the condition is the same as that given by 1 (or 2 if one prefers). An example of a fine-grained property is the property of being red to me in *this* my current circumstance. Cohen seems to call such properties fine-grained because the conditions necessary and sufficient for an object to have them are narrowly defined. For example, the property of being red to me in *this* circumstance (a low light environment) is a different property from being red to me in *that* circumstance (an environment in which the lighting is slightly brighter). With respect to these fine-grained colors, whenever a subject has a perception as of an object being a color, the object is that color. Thus, as I understand Cohen, Illusion and Incompatibility are false with respect to fine-grained colors. If Illusion is false, then P-Incompatibility is false too.

⁶² Cohen (2009; 2007, p. 340) accounts for errors in color perception due to hallucinations and deviant causal chains without having to distinguish between coarse-grained and fine-grained colors. Errors due to deviant causal chains cannot account for Illusion, because this intuition, as I define it, rules out deviant causal chains.

Cohen also claims that there are coarse-grained colors. With respect to these colors, R_L holds of $\langle x, y_1, y_2 \rangle$ iff y_1 is a *normal* viewing subject in a *normal* circumstance y_2 and y_1 has the perception as of x being L (or if one prefers iff if a *normal* viewing subject y_1 in a *normal* viewing circumstance y_2 were to view x , then y_1 would have a perception as of x being L).⁶³ An example of a coarse-grained color is the property of being red to perceivers similar to me (normal ones) in circumstances like those I usually encounter (normal ones). Cohen seems to call such colors coarse-grained because the conditions necessary and sufficient for an object to have them are broadly defined. For example, an object having the property dark-green to me in *this* circumstance (a low light environment) or the property light-green to me in *that* circumstance (an environment in which the lighting is brighter) can be compatible with it also being coarse-grained red. Incompatibility (or something close) holds for the coarse-grained colors. Thus, as I understand Cohen, Illusion is true with respect to these colors. I am here, of course, assuming that we perceive coarse-grained colors, because *these colors can only accommodate perceptual illusions if we perceive them. Misrepresentation requires representation*. To whatever degree Cohen can accommodate Illusion, he can accommodate Incompatibility and P-Incompatibility.

As emphasized above, Cohen's treatment only works if we perceive the coarse-grained colors. What determines whether one's perceptual system represents coarse-grained or fine-grained colors? Cohen gives an explanation involving a person named Sally (2007, p. 343; 2009, p. 129-130). In his explanation there is an unripe tomato under

⁶³ There are two important things to note here. First, Cohen thinks that there are no *principled* specifications of 'normal observer' and 'normal circumstances.' Second, it seems there can be different kinds of coarse-grained colors, but for simplicity I am just going to work with coarse-grained colors as I have defined them.

E viewing condition. E is such that (a) it lies outside the range of perceptual circumstances that Sally normally encounters, (b) the way the tomato appears to Sally in E is different from how it would appear in perceptual circumstances roughly similar to those she normally encounters, and (c) there are no visual clues about these facts. With (a)-(c) in mind, Cohen asks one to imagine that Sally naively directs her gaze towards the tomato. As I understand him, Cohen claims that Sally's perceptual system in this case misrepresents the tomato as having the coarse-grained color red to people like her in situations like those she normally encounters. Now, imagine that the experimenter explains to her about (a) and (b). With these facts explained, Cohen asks one to picture that the now informed Sally directs her gaze towards the tomato. I interpret Cohen to say in this case, as the informed Sally is aware of (a) and (b), that her perceptual system represents the tomato's color veridically as having the fine-grained color red to her in her current circumstances.

Is my understanding of Cohen correct? *Sometimes* Cohen talks in a way that suggests he thinks that perceptual systems do not represent coarse-grained colors (2009, p. 116). So, there is some reason to think that I am incorrect. However, elsewhere Cohen suggests that perceptual systems do indeed represent coarse-grained colors. Cohen (2007, p. 343; 2009, p. 130) when explaining the Sally case above says that, before learning about (a) and (b), Sally's misrepresentation as of the tomato being coarse-grained red is a "textbook case of perceptual illusion." Further down that same page, when talking about another example involving Sally's misrepresenting an object's coarse-grained color, he says, "Here, too, we have a case of illusory representation of the tomato's color" (2007; p. 343). There are other examples of Cohen talking about illusions in the context of

coarse-grained colors (2007; p. 347). One may ask, “Does Cohen define ‘illusion’ in some weird way?” No. Cohen says the following:

“An illusion occurs when the subject perceptually represents an object x that she is indeed perceiving, but errs in the features she perceptually represents x as bearing (either by perceptually representing x as bearing features that x in fact lacks, or by perceptually representing x as lacking features that x in fact bears).” (2007, p. 339)

So, given that Cohen defines illusions as having to do with perceptual misrepresentation, and says that Sally’s misrepresentation is an illusion, indeed a “perceptual illusion,” my interpretation of Cohen is at least very close to the surface in his work: Sally cannot have an illusion of the tomato’s coarse-grained color if she does not perceptually represent coarse-grained colors *given Cohen’s definition of ‘illusion.’*

Regardless, if perceptual systems do not represent coarse-grained colors, Cohen’s treatment cannot accommodate Illusion. As I said, the coarse-grained colors cannot accommodate perceptual illusions if we do not perceive them. One’s perceptual system cannot misrepresent something that it does not represent. If Cohen’s treatment cannot accommodate Illusion, it cannot accommodate P-Incompatibility, because these propositions are biconditionally connected. Of course, his treatment could still accommodate Incompatibility at least for coarse-grained colors, but this is not enough to give the relationalist treatment of Illusion that Cohen wants. So, to see whether his treatment can accommodate the relevant intuitions, there is reason to interpret him as I have, regardless of whether my interpretation provides the correct presentation of

Cohen's beliefs. This would be a bad way to go about things if my interpretation had nothing to offer over the interpretation under which perceptual systems do not represent coarse-grained colors. However, as I said, it is only under my interpretation, and not the other one, that Cohen's treatment can accommodate Illusion and so P-Incompatibility. With all this being said, *much of what I say in the next section applies regardless of whether coarse-grained colors are perceptually represented*. I shall explain why later.

3.2: The objection from motivation

I shall now argue that Cohen's treatment (of his view's unintuitive implications) is in tension with the motivation for his view. Cohen uses an instance of the color variation argument to support his view. The argument has an epistemic and a metaphysical interpretation. Cohen (2004, p. 455; 2009) explicitly says that his argument should be understood metaphysically. The metaphysical interpretation of the variation argument is as follows:

M1. There is nothing to make one variant veridical rather than another in either interspecies, intrapersonal, or interpersonal color variation cases.

M2. The best explanation of M1 is that Incompatibility, Realism, or Incompatibility and Objectivism is false.

(3). Therefore, Incompatibility, Realism, or Incompatibility and Objectivism is false.

Cohen thinks that the best explanation of M1 is that Incompatibility and Objectivism are false and believes that the denial of these propositions is best captured by his view. He calls this entire line of reasoning, "the argument from perceptual variation" (2009, p. 24).

To show that Cohen's treatment is in tension with the motivation for his view, I will show that it implies that often there is something to make one of the perceptual variants in color variation cases involving humans veridical rather than another. Call this, 'Often-Either.' According to Cohen's treatment, it is possible for one human perceptual variant to be veridical rather than another with respect to the coarse-grained colors. Naive Sally misrepresented the unripe tomato as being coarse-grained red, because she thought falsely that she was in normal circumstances. However, if naive Sally *had* been in normal circumstances, she would have represented the tomato veridically as being coarse-grained green. This is because unripe tomatoes appear green to normal observers in normal circumstances, and presumably Sally is a normal observer. Thus, to show that Cohen's treatment implies Often-Either, I only need to argue that it implies that we often represent the coarse-grained colors. Call this, 'Often-Coarse.'

The argument for Often-Coarse runs as follows: Most of the time, we tacitly believe that we are normal observers, and that we are in normal circumstances. Call this, 'Often-Tacit-Belief.' Cohen's treatment of Sally implies that what our perceptual systems represent is dependent on what we believe. The naive Sally's perceptual system represented the tomato as being coarse-grained red. Sally's perceptual system then changed from representing coarse-grained colors to representing fine-grained colors, because she learned about (a) and (b). So, Cohen's treatment of Sally implies that if we believe that we are normal observers in normal circumstances at time t , we represent objects as having the coarse-grained colors at t . Call this, 'Belief-Dependency.'

Conjoining Often-Tacit-Belief and Belief-Dependency, Often-Coarse follows. From here one can see that Cohen's treatment implies Often-Either.

From inspecting Cohen's argument, clearly Often-Either is in tension with M1. This premise says that there is nothing to make one of the variants in either interspecies, intrapersonal, or interpersonal color variation cases veridical rather than another. However, Often-Either says that there is often something to make one of the variants in color variation cases involving humans veridical rather than another, namely the coarse-grained colors. This shows that the instances of M1 dealing with humans (the intrapersonal and interpersonal instances) are incompatible with his "relationalist treatment." Moreover, Cohen (2007, p. 347) wants his treatment to apply to non-human animals as well. He says that it is "hardly extravagant or unusual" to claim that non-human animals have the kind of "tacit commitments" required for a variant of Often-Either dealing with non-human animals to be true. Hence, if Often-Either is true, then M1 of the argument from perceptual variation is in a precarious position. As I have shown, Often-Either follows from Cohen's "relationalist treatment." Thus, Cohen's treatment is in serious tension with his argument from perceptual variation.⁶⁴

Cohen could respond to this problem by rejecting Often-Either. He could do this by saying that perceptual systems do not represent coarse-grained colors. As I said in section 1, given this move, Cohen's treatment cannot accommodate Illusion and so cannot accommodate P-Incompatibility. Assuming Cohen wants to accommodate these intuitions, he must modify M1. He may try to do this by changing it to say that *in some fundamental sense* there is nothing to make one variant in color variation cases veridical

⁶⁴ A likely response is to say that only explicit beliefs influence what the perceptual system represents. If this response were plausible, Cohen could avoid my argument for Often-Coarse while accepting something like Belief-Dependency. Unfortunately, this response is not at all plausible. The masses seldom *explicitly* believe anything about their perceptual systems and viewing circumstances. Hence, if the response were correct, few people other than philosophers and color scientists would ever perceptually represent the coarse-grained colors. Thus, if the response were correct, ordinary perceptual illusion would be confined to intellectuals, and this over-intellectualization of ordinary perceptual illusion is clearly insane.

rather than another. One way to understand this that may occur to one from reading Cohen (2007, p. 347) is to make a distinction between the visual system and the perceptual system. The perceptual system could be understood as a larger structure than the visual system that includes elements of the cognitive system. With this distinction, one can define the fundamental sense in which there is nothing to make one variant in color variation cases veridical rather than another as having to do with the visual system alone. This move cannot work. It is analytic that the perceptual system is the system that allows us to perceive. So, if it were assumed that this system includes elements of the cognitive system, it would follow that these elements are necessary for perception. So, it would follow that the visual system alone is insufficient for perception. If this were true, it would follow that the visual system alone is irrelevant to perceptual variation arguments like Cohen's.⁶⁵

Regardless, it is going to take more than a modification of M1 to save Cohen's motivation for his view. The reason is that there remains a tension between Cohen's treatment and his basic arguments for M1 that is different from the tension just discussed. The difference is such that Cohen cannot avoid this new tension by saying that perceptual systems do not represent coarse-grained colors. Why this is will be explained soon. Cohen's basic arguments for M1 are the three arguments discussed in section 2 above for the three metaphysical instances of M1. The first argument is that it is difficult to imagine what could make one subject's perception as of color veridical rather than another's, given that both subjects are normal observers in identical conditions (2004; 2006a, p.

⁶⁵ Perhaps Cohen could develop an argument from visual variation, but this has yet to be done. More would have to be said to understand 'visual variation.' What exactly is 'visual variation' if not perceptual variation? Is there empirical support for it? Can it motivate CR? Why should we care about it? It is not even clear to me whether a distinction between visual and perceptual variation is conceptually coherent.

310; 2009, p. 25, 33). The second argument is that it is difficult to imagine what could make, for a single typical subject in typical conditions, one of his perceptions as of color veridical rather than another (2004; 2009, p. 19-25).

The tension between Cohen's treatment and these arguments for MI is that coarse-grained color properties provide an easy route for imagining what could make one perception as of color veridical rather than another: What could make one perception as of a coarse-grained color veridical rather than another is that one perception represents a coarse-grained color that is in fact there and another represents a coarse-grained color that is not in fact there. This tension is a grave problem for Cohen. His opponents say that it is easy to imagine what could make one perception veridical rather than another: What could make one perception veridical rather than another is that one perception represents a color that is in fact there and another represents a color that is not in fact there (Byrne and Hilbert, 2003a; 2003b; 2004). Coarse-grained colors make the situation worse. If one can imagine coarse-grained colors making one perception veridical rather than another, one can also imagine *non-relational colors* doing this. The reason is that the metaphysical story for how one perception gets to be veridical rather than another is the same regardless of whether one is talking about coarse-grained colors or non-relational colors. For both types of colors the story runs as follows: One perception represents a property that is not in fact there and the other represents a property that is in fact there.

This tension between Cohen's treatment and the above argument for M1 remains regardless of whether the representation of coarse-grained colors is confined to our language and thoughts as Cohen sometimes suggests. If one can imagine coarse-grained colors making one color ascription or thought right rather than another, one can imagine

non-relational colors making one perception veridical rather than another. The reason for this is that the metaphysical story about how one perception gets to be veridical rather than another is the same as the story about how one color ascription or thought gets to be right rather than another. For color ascriptions, thoughts, and color perceptions the story runs as follows: One perception or ascription or thought represents a property that is not in fact there and another perception or ascription or thought represents a property that is in fact there. This story should be familiar. It is the story about how one representation gets to be correct rather than another, and is relevant to perception, language, thought, etc. As the same story is relevant to all these forms, if one can imagine a representation of one form being right rather than another of that form, one can imagine a representation of another form being right rather than another of that same form.

The third argument Cohen gives for M1 presupposes that non-human animals differ in the perceptual discriminations that they make. As previously stated, there are four options. (I) Both the pigeons and humans' perceptions of *L* are veridical, but only the humans represent color properties. The human represents *L* as having a color *y*, and the pigeon represents *L* as having a color* *z* (which to be clear is not a color property). (II) The pigeons' perceptions of *L* veridically represent its color, but the humans' perceptions falsidically represent its color (or vice versa). (III) Neither the pigeons nor the humans veridically represent the color of *L*. (IV) Both the pigeons and humans' perceptions of *L* are veridical, and their experiences both represent color properties. The human represents *L* as having a color *y*, and the pigeon represents *L* as having a color *z*. Cohen says that (I)-(III) are revisionary, thus option (IV) is the best one available. Therefore, the relevant interspecies instance of M1 must be true.

The tension between this basic argument and Cohen's treatment is that the coarse/fine-grained color distinction is revisionary. This is because the idea that coarse-grained red and fine-grained red are both kinds of being red is unusual indeed. This tension is a serious problem for Cohen. The reason is that if one thinks that (I) is too revisionary, then one ought to question whether the coarse/fine-grained distinction is too revisionary. After all, the coarse/fine-grained distinction may be just as revisionary as the view that non-human animals do not perceive colors. Even if the coarse/fine-grained distinction were less revisionary than the view that non-human animals do not perceive colors, *it would not obviously be less revisionary* and so more would need to be said. Like with the last tensions, this tension remains regardless of whether the representation of coarse-grained colors is confined to our talk and thoughts. The distinction is revisionary because it says that coarse and fine-grained red are kinds of being red, but the only normally recognized kinds of being red are its determinates like being scarlet.

3.3: Is there a way out?

Cohen could try to reformulate his first basic argument for M1 to say that it is difficult to imagine that there is *no fundamental sense* in which when two subjects' perceptions as of color disagree they are both veridical, and his second to say that it is difficult to imagine that there is *no fundamental sense* in which when two perceptions as of color had by a single subject disagree they are both veridical. Unfortunately, these reformulations are still in tension with Cohen's treatment. Let me explain. If one can imagine coarse-grained colors making one perception veridical (or one color ascription or thought correct) rather than another, one can imagine a fundamental sense in which there is something to make

one color perception veridical (or one color ascription or thought correct) rather than another. If one can imagine this, one should have no trouble imagining that there is no fundamental sense in which when two color perceptions (or ascriptions or thoughts) disagree they are both veridical: One need only imagine that there are only coarse-grained colors and that the fine-grained “colors” are not really colors. From here, one should have no trouble imagining that there are non-relational colors to make one perception veridical rather than another. The reason is that the metaphysical story for how one perception (or one color ascription or thought) gets to be veridical rather than another is identical regardless of whether one is talking about coarse-grained colors or non-relational colors.

It is tricky to see how a response to the tension with Cohen’s third argument for M1 would go. Cohen must (at the very least) argue that the coarse/fine-grained distinction is less revisionary than the view that non-human animals do not see colors, but doing this will not be easy. Most philosophers do not hold Cohen’s fine/coarse-grained color distinction (Hacker, 1991; Campbell, 1993; Tye, 2000; Byrne and Hilbert, 2003a), so Cohen probably cannot appeal to philosophers’ beliefs. Moreover, scientists are careful to rely on behavioral definitions of color vision (Jacobs & Deegan, 1999; Palacios et al., 1990; Wright & Cumming, 1971). For example, Griebel and Peichl say in their article that “[t]he term ‘color vision’ refers to the capability of a visual system to respond differently to light differing in wavelength only” (2003, p. 19). As a result, scientists issue warnings about claiming that non-human animals see colors (Hardin, 1988, p. 148). Thus, Cohen probably can only appeal to the beliefs of ordinary people. However, the empirical evidence suggests that ordinary folk are not relationalists about color but rather

anti-relationalists (Roberts et al, 2014). So, appealing to them is a bad option for Cohen. If ordinary people are to decide these issues, Cohen's view is in serious trouble.

As I have shown, the prospects for reformulated arguments for M1 are dim. So, it seems that Cohen must give up on his treatment. I have already argued that the tension between Cohen's basic arguments for M1 and his treatment remains regardless of whether coarse-grained colors are only represented at the level of language and thought. Thus, Cohen cannot retreat to this interpretation even if he wanted to. Assuming he could, does Cohen provide any argument that we should not trust the intuition that Illusion is true and the intuition that P-Incompatibility is true? (Recall that if we do not perceive the coarse-grained colors, Cohen's treatment cannot accommodate Illusion and P-Incompatibility.) The following argument is close to the surface in Cohen (2007, p. 348-349): Armchair reflection cannot distinguish between language and thought on the one hand and perception on the other. So, deciding whether ordinary perceptual illusion cases occur should be left to empirical inquiry. Science may teach us that the only ordinary color "illusions" that occur are those of language and thought. Thus, the intuition for Illusion should not be trusted and so neither the one for P-Incompatibility.⁶⁶

This is a poor attempt to explain away the relevant intuitions. It is unbelievable that armchair reflection is unable to distinguish between language and thought, and perception. People can easily distinguish between what they are saying and thinking on

⁶⁶ This is the passage I am pulling this argument from. "[A]n opponent will suggest [that] what is needed is that there are illusions involving the representations of color in the visual system *per se*—i.e., in the visual system considered on its own, rather than considered as part of a larger cognitive/perceptual system. But I think this objection depends on treating our intuitions about error with much more evidential authority than they deserve. [...] [I]t is hard to see why we should trust intuitions about how the labor of producing these errors is divided between the visual system and other components of the cognitive/perceptual system. Surely that's something to be sorted out by (broadly) empirical inquiry, not by the armchair consultation of intuitions." (2007, p. 348-349)

the one hand and what they are perceiving on the other. A world in which people could not do this would be a world in which people could not distinguish between talking about or thinking about a unicorn on the one hand and perceiving a unicorn on the other. This fantasy is not the actual world. Therefore, armchair reflection is able to distinguish between language and thought on the one hand and perception on the other. Empirical enquiry is not needed. One may reply that it may not be so obvious philosophically where thinking ends and perceiving begins. However, whether there are philosophical thought experiments in which people cannot easily distinguish thought from perception is irrelevant to whether Cohen's argument works. Our intuitions about Illusion and P-Incompatibility are not based on these hard cases but everyday experience.

There is an analogy in Cohen (2007, p. 349) with acceptability judgments that one could try to use to support the claim that armchair reflection cannot distinguish between language and thought on the one hand and perception on the other. Cohen says that, although it is reasonable to insist that 'the bulldogs the bulldogs the bulldogs fight fight fight' is unacceptable, it is unreasonable to insist that it is unacceptable because of the grammar of the language in particular, as opposed to being unacceptable for some other reason. The reason it is unreasonable to do this, according to Cohen, is that it is up to empirical enquiry not armchair consultation of intuitions to determine why exactly the relevant phrase is unacceptable.⁶⁷

⁶⁷ This is the bit of text I am interpreting. "By way of analogy, consider what the linguist says about acceptability judgments. It is reasonable to insist, on the basis of considering your own reactions to the cases, that *the bulldogs fight* is acceptable and that *the bulldogs the bulldogs the bulldogs fight fight fight* is unacceptable [...] But it is not reasonable to insist, on the basis of considering your own reaction to the case, that the unacceptability of the latter string is due to its failure to conform to the grammar of the language in particular. On the contrary, the standard story goes, acceptability judgments are the result of the interaction of the grammaticality faculty with other components in the cognitive system [...], and it is up to systematic empirical inquiry, as opposed to armchair consultation of intuitions, to dole out the labor of explaining the phenomena." (2007, p. 349)

This analogy cannot provide the needed support. Cohen may be right that it is unreasonable to insist that the unacceptability of the string of text is due to the grammar of the language. Perhaps armchair reflection cannot easily distinguish between a sentence being ungrammatical and its other problems. If so, there is good reason not to trust our intuitions that the relevant string is ungrammatical in particular. Regardless, there is a strong disanalogy between reflection on the grammaticality of sentences and reflection on perception. Being able to tell ungrammatical sentences from grammatical ones is a difficult task that requires a lot of training. Even university students sometimes fail to write grammatically. Conversely, being able to differentiate language and thought on the one hand from perception on the other is something that if learned at all, is learned at a young age. So, the analogy fails to support Cohen's claim that armchair reflection cannot distinguish between language and thought on the one hand and perception on the other. People can at least distinguish between language and thought, and perception in everyday cases on which the relevant intuitions are based.

Summary of section 3

I have been examining whether Cohen's "relationalist treatment" of ordinary perceptual illusion can succeed. I first focused on distilling Cohen's treatment and defending my interpretation (section 3.1). I then argued that Cohen's treatment, as I understand it, is in serious tension with his argument from perceptual variation, and that his response regardless of interpretation is in tension with his basic arguments for the first premise of his argument from perceptual variation (section 3.2). Finally, I looked at whether Cohen

can evade my arguments against his treatment (section 3.3). Namely, I looked at whether his basic arguments can be modified to avoid said tensions and at an attempt to explain away our intuitions. Most generally, I have shown that Cohen's "relationalist treatment" has killed his patient.

Section 4: The introspective rejoinder⁶⁸

A popular and influential objection to Cohen's relationalism is that the view is opposed to our phenomenally-informed, pre-theoretic intuitions. So, as the objection goes, because relationalism is opposed to these intuitions, we should reject the view. I, along with Cohen and Nichols (2010), shall call this argument, "the introspective rejoinder." Many who have thought about color can be interpreted as endorsing the introspective rejoinder (at least to some degree) (Armstrong, 1987, p. 36-37; Boghossian and Velleman, 1989, p. 86; Chalmers 2006, p. 56–77ff; Dancy, 1986, p. 181; Gibbard, 2006, p. 10; Johnston, 1992, p. 226–27; Yablo 1995, p. 489).⁶⁹ Here are two examples.

But surely [relationalism] misrepresents the phenomenology of colour perception: when we see an object as red we see it as having a simple, monadic, local property of the object's surface. The colour is perceived as intrinsic to the object, in much the way that shape and size are perceived as intrinsic. No relation to perceivers enters into how the colour appears; the colour is perceived as wholly on the object, not as somehow straddling the gap between it and the perceiver. Being seen as red is not like being seen as larger than or to the left of. The 'colour envelope' that delimits an object stops at the object's spatial boundaries. So if colour were inherently relational, [...] then perception of colour would misrepresent its structure – we would be under the illusion that a relational property is non-relational. Contraposing, given that perception is generally veridical as to colour, colours are not relational [...]. (McGinn 1996, p. 541–42)

⁶⁸ The work on this section is the result of collaboration with James Andow (A PhD graduate from the University of Nottingham) and Kelly Schmidtke (A research fellow at Warwick). The work has resulted in a co-authored publication in *Erkenntnis*. Please see Roberts, Andow, & Schmidtke (2014). The work can also be accessed online at <http://link.springer.com/article/10.1007%2Fs10670-014-9600-6>

⁶⁹ Cohen and Nichols' (2010) also interpret each of these philosophers as endorsing the introspective rejoinder.

Still, it may be insisted, the relational view of colour [...] surely goes against ordinary colour experience. When, for example, a rubber ball looks blue to me, I experience blueness all over the facing surface of the ball. Each perceptible part of the ball looks blue to me. And none of these parts, in looking blue, look to me to have a relational property. On the contrary, it may be said, I experience blueness as intrinsic to the surface, just as I experience the shape of the surface as intrinsic to it. This simple fact is one that relational approaches to colour cannot accommodate without supposing that a universal illusion is involved in normal experiences of colour – that colours are really relational properties even though we experience them as non-relational. (Tye 2000, p. 152–53)

The introspective rejoinder has been raised with such force and regularity that it is clear many with different theoretical commitments take the rejoinder to be a persuasive argument against Cohen’s relationalism (Cohen and Nichols, 2010, p. 221). The rejoinder supposes that *phenomenally-informed* intuitions provide defeasible evidence about the nature of color (although for readability I will often merely talk of ‘pre-theoretic intuitions’ or just ‘intuitions’). There is good reason to accept this principle *about color*, regardless of whether a similar principle holds with respect to things other than color: The rich phenomenal character of color experiences is an important guide as to the nature of color properties.⁷⁰ Indeed, I am inclined to think that any account of color which ignored the phenomenal character of color experience would risk failing to give an account of *color*, as it would risk changing the subject. So, it is natural to treat intuitions that are informed by how the colors appear in perception as providing defeasible evidence as to the nature of colors. The importance of *phenomenally-informed* intuitions is also the reason that the rejoinder concerns *pre-theoretic* intuitions. Any theoretical

⁷⁰ My claim here is not a strong one. I think that, *with respect to color*, phenomenal character has *at least some* bearing on representational content *in typical, every-day cases*. This weak premise is all that is needed to motivate the introspective rejoinder. Accepting it, for example, in no way commits one to any *necessary* connections between phenomenal character and representational content (i.e. to any form of intentionalism).

commitments an individual has are likely to influence their intuitions hence limiting the extent to which their intuitions are based on how the colors look.

As I think that the rich phenomenal character of color experiences is an important guide as to the nature of the colors, I believe that proponents of relationalist views on color must take the introspective rejoinder seriously. If the rejoinder is correct about our intuitions, the relationalist risks having to say that our intuitions are somehow misfiring and perhaps that “a universal illusion is involved in normal experiences of color” (Tye, 2000, p. 152-153). With others in the debate, I think this is a problem for the relationalist. While widespread mistakes and/or illusions about color are, of course, possible, I think them implausible and cannot imagine the relationalist giving a convincing response.

In the rest of section 4, I demonstrate that the introspective rejoinder is correct about our pre-theoretic intuitions. Cohen and Nichols’ (2010) study suggests that about half (47%) of their participants are relationalists about color. Hence, their study provides reason to doubt that the introspective rejoinder is correct about our pre-theoretic intuitions. I note a number of reasons to be worried about the design of Cohen and Nichols’ study (Sect. 4.1), and conduct an improved study of my own (Sect. 4.2). Contrary to Cohen and Nichols’ results, my findings (Sect. 4.3) suggest that anti-relationalism is the pre-theoretically intuitive position. Thus, my study suggests that the introspective rejoinder is accurate about our intuitions. I find some other interesting things. My results suggest that most ordinary people do not find it less intuitive that colors are objective than that shapes are. I also find some evidence, which amongst other things will be discussed in the final section (Sect. 4.4), that when ordinary people are asked just about the colors of objects, their intuitions about color and shape cases are

similar, but when asked to evaluate people's color ascriptions, their intuitions about color and shape cases differ.

4.1 Cohen and Nichols' experiment

Cohen and Nichols ran an experiment to see whether the introspective rejoinder is correct about our pre-theoretic intuitions. They presented participants in an introductory logic class with cases involving putative disagreements about color and shape properties.⁷¹ In an effort to prevent participants from using linguistic differences to explain the putative disagreements, participants were provided with a background story involving aliens with perceptual systems that differ from ours. Here is an example.

[Andrew and Abigail are] aliens from different planets. They learn English by reading books, and attain native fluency. Their use of English words is no more different from yours than that of other native speakers of English is from yours. But these aliens have different perceptual systems from ours. Consequently, when the aliens visit Earth on a spaceship and talk with their friend Harry the human, they sometimes disagree about whether a given English word applies to something. Your job is to help us settle these disputes. (2010, p. 221)

After receiving this background description, Cohen and Nichols' participants received cases of putative disagreement involving a tomato and the colors red and green, and a compact disc (or CD) and the shapes round and triangular. Their cases were worded as follows:

Andrew [or Abigail] the alien and Harry the human view a ripe tomato [or an ordinary compact disc] in good light, at a distance of 1 metre. Harry says that the ripe tomato is red [or that the CD is round], while Andrew [or Abigail] says that

⁷¹ Cohen and Nichols also presented participants with putative disagreement cases involving gustatory properties (sweet, bitter, and sour) as well as cases involving the property deliciousness (2010, p. 221). The vast majority of their participants selected the relationalist option for both kinds of properties (2010, p. 223-224). I concentrate on shape and color, because it is these results that are integral to my defense of the introspective rejoinder.

the very same ripe tomato is not red (in fact, he says it is green) [or that the CD is not round (in fact, she says it is triangular)]. (2010, p. 222)

After reading the cases, participants were asked to select one of three options. Below are the options that were available.

- 1) The tomato is red [or the CD is round], so Harry is right and Andrew [or Abigail] is wrong.
- 2) The tomato is not red [or the CD is not round], so Andrew [or Abigail] is right and Harry is wrong.
- 3) There is no fact of the matter about unqualified claims like ‘the tomato is red’ [or ‘the CD is round’]. Different people have different visual experiences when they look at the same object, and it is not absolutely true or false that the tomato is red [or that the CD is round]. (2010, p. 222)

Cohen and Nichols (2010) found that 47% selected option (3) when presented with the color case and so seemed to be color relationalists, and that 30.9% selected option (3) when presented with the shape case and so appeared to be relationalists about shape. To be clear, option (3) is supposedly the relationalist friendly option, because it suggests that there is a subjectivity in the nature of the colors that the anti-relationalist would find troubling but that most relationalists would endorse, especially those of Cohen’s ecumenical variety (2004; 2009). Sign tests revealed that participants were more likely to choose the relationalist answer for colors than for shapes. This data suggests, contrary to the introspective rejoinder, that “the introspective capacities available to normal adults do not, by themselves, supply authoritative and unambiguous data about whether the colors are relational” (Cohen and Nichols, 2010, p. 226). Thus, Cohen and Nichols’ results suggest that there is no sense in which the introspective rejoinder is correct that Cohen’s relationalism is opposed to our pre-theoretic intuitions.

Cohen and Nichols' results are contrary to what I would have expected. I first became suspicious of their study after noticing that 30.9% of their participants selected relationalism about *shape*. As shapes are very obviously non-relational (in the relevant sense), this suggested that there was something about Cohen and Nichols' experimental design that biased their participants in favour of relationalism. I noticed some other things straight away that struck me as odd. For example, Cohen and Nichols background description includes the stipulation that “[The aliens’] use of English words is no more different from yours than that of other native speakers of English is from yours” (2010, p. 221), but then in their cases the aliens use the English words “round” and “red” in ways that are utterly distinct from how normal English-speaking subjects use them (e.g. the aliens say things like “the CD is not round”). Upon examining their experiment more closely, I discovered four further reasons to be concerned.

First, their relationalist option, their option (3), is composed of the following three distinct propositions:

- (a). There is no fact of the matter about unqualified claims like [e.g. “the tomato is red”].
- (b). Different people have different visual experiences when they look at the same object.
- (c). It is not absolutely true or false that [e.g. the tomato is red].

This is an unwieldy mixture. One thing that is worrying is that the relationalist option includes (b). Participants may find (b) to be a likely explanation for why Andrew and Harry [or Abigail and Harry] disagree. If different people have different visual experiences when they look at the same object, then this would probably result in, for

instance, Andrew and Harry disagreeing about the tomato's color. Thus, participants may choose the relationalist option in order to choose (b). Unfortunately, (b) is consistent with both relationalism and with anti-relationalism.⁷²

Second, given how Cohen and Nichols set up their experiment, the only alternatives to the relationalist option are to commit oneself to saying that Harry is right (option 1) or to commit oneself to saying that Andrew [or Abigail] is right (option 2). So, for the anti-relationalist to express their intuitions, they must say that Harry is right or that Andrew [or Abigail] is right. The shape case involves a compact disc. So, Harry is obviously correct and Abigail wrong (assuming she is speaking English), because discs are round by definition. However, it is unobvious whether in the color case Harry or Andrew (if either) is right. Ripe tomatoes of the common variety are red, but this is not true for all varieties. Thus, Cohen and Nichols' setup may bias anti-relationalists towards the relationalist option in the color case; participants with anti-relationalist intuitions may choose the relationalist option in the color case to avoid saying that Harry is right or that Andrew is right, because they are uncertain which (if either) is right.

Third, Cohen and Nichols' background description, which is supposed to prevent participants from interpreting the disagreement case as being due to linguistic differences, involves aliens with perceptual systems that differ from ours. Participants may find it intuitive that aliens with different perceptual systems do not see colors and shapes (or at least not the same ones that we see) and so plausibly would mean something different from us by "The tomato is red" and "The CD is round." So, Cohen and Nichols'

⁷² There is another worry with (b). If one interprets 'different visual experiences' to mean 'numerically different visual experiences', then (b) is as close to undeniable as anything is in philosophy. So, it is reasonable to hold that upon reflection people would find that (b) is certain under this reading. So, participants may choose the relationalist option to choose (b), because they are certain that (b) is true under the relevant reading.

background description may have betrayed its purpose by skewing participants towards treating Harry and Andrew's [or Harry and Abigail's] dispute as being due to linguistic differences. There are reasons to suspect that this third concern would have more of an influence on participants' judgements about color than their judgements about shape. First, participants may be sensitive to the idea that seeing shapes is universally important to surviving, but that the importance of being able to see colors (or the colors that we see) is more environmentally dependent.⁷³ Second, participants may be sensitive to the idea that there are mathematical definitions for shapes but not for colors that the aliens could rely on to avoid a verbal dispute even if things look somewhat different to them.

Fourth, I am worried that participants may chose the relationalist option in order to express a feeling that no one is at fault. Participants may associate someone being wrong with their being at fault for being wrong, because when one is wrong one is also often at fault for it. Option (1) implies that Andrew [or Abigail] is wrong and option (2) that Harry is. So, because of the association that participants may have, they may feel that by agreeing with (1) they are agreeing that Andrew [or Abigail] is at fault and by agreeing with (2) that Harry is at fault. However, participants may not feel as if either (or both) is at fault for being wrong, because they may think that whether Andrew or Harry [or Abigail or Harry] is wrong (or whether they both are) is due to factors that are outside of their control like a visual system malfunction. Participants may be particularly likely to think this in the color case because of the well-known phenomenon of color blindness, an inherited trait for which one is not responsible.

⁷³ There is empirical evidence that the importance of being able to see colours is environmentally dependent. For example see, Changizi *et al*, 2006.

4.2: My method

I ran an experiment to test pre-theoretic intuitions designed to avoid the problems with Cohen and Nichols' study mentioned above. All 129 of the participants (61 male) completed an online survey. Of the participants, 31 had postgraduate experience in philosophy, including some faculty, and the remaining 98 either had no training in philosophy or at most had completed an undergraduate degree in philosophy.⁷⁴

Participants either received a case involving color disagreement ($N = 65$) or one involving shape disagreement (but never both) as follows:

Disagreement case. Alex and Harry examine an object. Alex and Harry examine the object in typical lighting from the same position. They are both fluent English speakers and have normal eyesight. Harry says that the object is red [or round], while Alex says that the very same object is green [or cube shaped].

After reading either a color or shape case, participants were asked to evaluate 7 statements on a likert scale with 10 items from disagree to agree:

Epistemic. We could find out who is right about the colour [or shape] of the object.

Fault. One of them, and possibly both, is at fault for getting the colour [or shape] wrong.

Appearance. The object may appear in different ways to Alex and Harry, and so, for all we know, both of them could be correctly reporting how the object appears to them.

⁷⁴ These participants were recruited in two sections. The first 67 participants were recruited spring 2013 using social media and through the University of Nottingham. The remaining 62 participants were recruited autumn 2013 through the University of Warwick's Behavioural Science Group's participant recruitment system.

Meaning. Alex and Harry may only disagree about what the words "red" and "green" [or "round" and "cube shaped"] mean, and so given how they may be individually using the words, they could for all we know both be right about the colour [or shape] of the object.

Verbal. People often disagree about what word best describes how an object appears. For example, people often disagree about whether something should be called "red" or "orange" [or "round" or "cube"].

Perceptual. People disagree a lot about what colours [or shapes] things perceptually appear to have.

Target. In reality, there is an absolute fact of the matter about the colour [or shape] of the object regardless of how it appears to Alex and Harry and regardless of what they think, say, or do.

Note that *Target* is about the color [or shape] of the object. The reason why *Target* is phrased this way is that relationalism and anti-relationalism are metaphysical views and not views on how people use color [or shape] language. An additional reason for this phrasing concerns Cohen's (2007; 2009) distinction between fine/coarse-grained colors. When it comes to fine-grained colors, everyone is more or less guaranteed to be right according to Cohen. However, Cohen seems to hold that typically people ascribe (in language) coarse-grained colors to objects. Coarse-grained color properties are such that error can much more easily occur, because these colors are constituted by relations that hold between objects and *normal* observers and conditions. Given this subtlety in Cohen's account, it would be difficult to interpret a question about color ascriptions rather than the colors themselves, hence I decided to focus only on the latter.

The order of the first six statements above was randomized, but *Target* always came last. I did this because I was worried that participants would disagree with *Target* in order to express something unrelated to their relationalist intuitions and hoped that the first six statements would help to disambiguate *Target* so that this would not happen. For

example, I had a concern, similar to my final worry with Cohen and Nichols' study, that participants would disagree with *Target* in order to express that no one is at fault for being wrong about the object's color or shape. Participants may think that by agreeing with *Target* they are agreeing with the proposition that Alex is at fault or Harry is (or that both are at fault) for being wrong.⁷⁵

4. 3: My results

The majority of participants responded 6 to 10 on *Target* indicating some degree of agreement with anti-relationalism in both the color (72.30%) and the shape (85.90%) conditions. Interestingly, the results suggest different trends depending on the level of experience that participants have in philosophy. Among those with postgraduate experience in philosophy (including university faculty), call this group 'Philpost', fewer participants agreed with anti-relationalism about color (64.70%) than shape (92.90%). In comparison, among those who either had no experience in philosophy or whose highest experience in philosophy was at an undergraduate level, call this group 'Not-Philpost', a more similar number of participants agreed with both anti-relationalism about color (75.00%) and shape (84.00%), see fig. 3.3.

⁷⁵ There are various reasons why disambiguating statements like *Target* is important in experimental philosophy. One should not assume that participants will understand terms like "truth", "fact of the matter", "correct" and "accurate" the way we do. This is a lesson we can learn from the work of the "Oslo School", e.g., Arne Naess and Herman Tennesen—work which is sometimes touted as early experimental philosophy. Another illustrative example is that of Fain and Kaelin (1960) who, in a similar early empirical study, found an astonishing level of agreement among philosophy undergraduates that all or most truths are relative (at the beginning of term 80% and 83% in consecutive years, and at the end of term 65% and 56%). On further investigation they found that "when a student says that the same proposition can be true for one person and false for another, he usually means something quite innocent: that the same proposition can be believed and disbelieved by different people at the same time" (p.142).

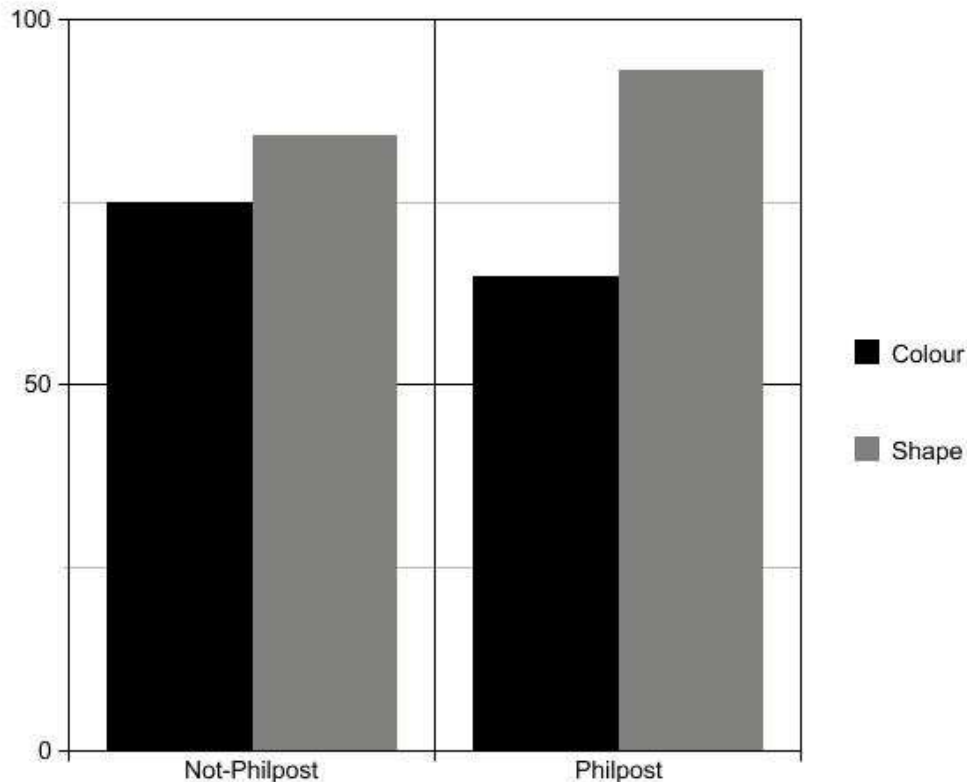


Figure 3.3. *Division of participants. The percentage of participants divided into Not-Philpost and Philpost, and color and shape cases who indicated some agreement (likert scale 6-10) with anti-relationalism.*

Are there any significant differences for property type (color, shape)? The Mann-Whitney test, a nonparametric alternative to a t-test, indicated no significant difference between the way *Target* was rated in color and shape conditions on a scale of 1-10 when all participants were analyzed ($z = 1.76, p = 0.08$), although the result did approach significance. I find no evidence of a difference whatsoever in Not-Philpost between the way color and shape were rated ($z = 0.84, p = 0.41$). Contrary to this, I find that the likert ratings are different for color and shape in Philpost ($z = 2.07, p < 0.05$). So, it should be clear that it was those in Philpost who were causing the results for all participants to

approach significance. There is no evidence that those in Not-Philpost recognize a difference between color and shape.⁷⁶

The Mann-Whitney test was performed on the six disambiguating statements to test for a difference between the way color and shape were rated when all participants were analyzed together and then for the subgroups. I did this because I was interested in exploring how the participants understand color and shape cases, and thought that I might learn something interesting by looking at how the participants rated the disambiguating statements in depth. For all participants, differences were found for *Appearance* ($z = 2.18, p < 0.05$), *Verbal* ($z = 5.80, p < 0.01$), and *Perceptual* ($z = 2.83, p < 0.01$). For Not-Philpost the differences remained for *Verbal* ($z = 5.62, p < 0.01$) and *Perceptual* ($z = 2.66, p < 0.01$). In contrast, none of the differences were significant for Philpost, with only *Perceptual* approaching significance ($z = 1.90, p = 0.06$).

I further examined the relationships between the seven statements using Spearman's rho correlation matrices. For simplicity, I will only talk about the results arrived at when analyzing all of the participants together. Table 3.1 is included for anyone interested in whether the correlations hold for the subgroups and notes some differences between them. My findings support some of my concerns with Cohen and Nichols' study and shed light on the Mann-Whitney differences found for *Target*, *Appearance*, *Verbal*, and *Perceptual*.

⁷⁶ A critic might note that our between-subjects design could hide within-subject differences, like the results Cohen and Nichols found. To mitigate these concerns, 52 willing participants from the University of Warwick were sent a second survey about whichever property they did not respond to originally in a follow up email a week later. In total, 37 participants responded to the second survey (18 color).

Descriptively, the participants' responses to *Target* for both color and shape are very similar. For color the median response was eight; while for shape the median response was nine. Notably, the modal responses for both color and shape were 10. Statistically, these results were compared with a sign test, a non-parametric alternative to the repeated samples *t*-test. The test found no difference between participants' color and shape responses ($z = 1.24, p = 0.21$). Thus, even employing a within-samples design, like Cohen and Nichols, we find no difference between participants' color and shape *Target* responses.

Spearman's Rank Order Correlations	<u>All Participants</u>		<u>Not-Philpost</u>		<u>Philpost</u>	
	Color <i>N</i> = 65	Shape <i>N</i> = 64	Color <i>N</i> = 48	Shape <i>N</i> = 50	Color <i>N</i> = 17	Shape <i>N</i> = 14
Target – Epistemic	**	**	**	**	*	
Target - Fault	**		**		**	
Epistemic – Fault	**		**		**	
Appearance - Meaning	*	**	**	**		**
Appearance – Verbal	*		**			
Appearance - Perceptual	*		**	*		
Appearance - Fault		*		*		
Verbal – Meaning	*					
Verbal – Perceptual	**	**	**	**	**	*
Perceptual – Meaning	*					

Table 3.1 *Spearman's correlations. Rank Order correlations for all participants and across subgroups. Notes: * $p < 0.05$. ** $p < 0.01$.*

Interesting patterns were observed for *Target* between the color and shape correlation matrices. When looking at participants' responses to the color case, I found that *Target* correlates with both *Epistemic* and *Fault* (respectively, $r = 0.52, p < 0.01$; $r = 0.40, p < 0.01$). In contrast, for participants' responses to the shape case, *Target* was

found to only correlate with *Epistemic* ($r = 0.35, p < 0.01$). The discovery that *Fault* is uniquely associated with participants' responses to *Target* in the color case supports my fourth concern with Cohen and Nichols' study. This worry was that Cohen and Nichols' participants may choose the relationalist option in the color case in order to avoid attributing fault to the relevant parties. The fact that *Fault* is uniquely associated with participants' color responses supports my fourth concern, because it is what one would expect to find if participants in Cohen and Nichols' study were choosing the relationalist option in the color case in order to avoid attributing fault: If participants were choosing the relationalist option to avoid attributing fault, one would expect those who chose this option to disagree with a statement that attributes fault.

Examining *Appearance* I find that there is a significant relationship between this statement and *Meaning* for both the color and shape cases (respectively, $r = 0.31, p < 0.05$; $r = 0.50, p < 0.01$). The correlation between *Appearance* and *Meaning* supports my third worry with Cohen and Nichols' study that their background description using aliens with unique perceptual systems might have led their participants to believe that the dispute between the aliens and the humans is only due to linguistic differences. This correlation supports my third worry because it is exactly what one would expect to find if the worry were correct: If differences in how things appear, which would plausibly result from the aliens having different perceptual systems, lead participants to think there is merely a linguistic dispute going on, one would expect the discovered correlation to obtain. My third worry could explain why Cohen and Nichols' study seemed to find such a large percentage of relationalists about both color and shape.

I found three more correlations having to do with *Appearance*. For the color case I find a significant relationship between *Appearance* and *Verbal* ($r = 0.27, p < 0.05$). This was to be expected, for if something looks different to two people, they are likely to use different words to describe that thing. For the color case I also find a significant relationship between *Appearance* and *Perceptual* ($r = 0.29, p < 0.05$). This was also to be expected, because intuitively differences in how things appear lead to perceptual differences. Interestingly, I find neither of these correlations for the shape case. This absence probably has something to do with the fact that shapes have mathematical definitions that go beyond how they look. For the shape case I find a relationship between *Appearance* and *Fault* ($r = -0.27, p < 0.05$). Interestingly, I do not find this correlation for the color case. The explanation for this is difficult to see.

From examining *Verbal*, I find an interesting difference between participants' color and shape responses. When looking at participants' color responses a correlation emerges between *Verbal* and *Meaning* ($r = 0.29, p < 0.05$). This correlation was to be expected, because it is intuitive that two people whose colour terms have different meanings would end up using different colour terms to describe the same object (i.e., to verbal differences). However, interestingly, this relationship is not significant for the shape analyses. This suggests that the connection between *Verbal* and *Meaning* is stronger for color than shape. Perhaps this is because people are not as willing to allow shape terms to have alternative meanings as they are willing to allow color terms to. This in turn may have something to do with the fact that shapes have mathematical definitions.⁷⁷

⁷⁷ A significant correlation also emerged between *Verbal* and *Perceptual* for both color and shape cases. This correlation was to be expected and suggests that participants were paying attention.

I shall now look at *Perceptual*. I observed a correlation between this statement and *Meaning* for participants' responses in the color case ($r = 0.28, p < 0.05$). This finding, like the finding regarding the relationship between *Appearance* and *Meaning*, supports my third worry with Cohen and Nichols' study. The third worry, again, is that Cohen and Nichols' background description involving aliens with different perceptual systems might have led their participants to think that the dispute between the aliens and the humans is only due to linguistic differences. The correlation supports this worry because it is what one would expect to find if it were correct: If perceptual differences, which would likely result from the aliens having different perceptual systems from humans, lead participants to think there is merely a linguistic dispute going on, one would expect the mentioned correlation to obtain. Moreover, it seems I may have been right to suspect that the background description involving aliens would have more of an impact on participants' color than shape judgements; I find no significant relationship between *Perceptual* and *Meaning* for shape ($r = 0.08, p = 0.51$).

4.4: Discussion

Cohen and Nichols' study called the introspective rejoinder into question, because their results suggested that the introspective capacities available to ordinary people do not provide unambiguous data about whether the colors are relational (2010, p. 226). This is a problem for the introspective rejoinder, because if our introspective capacities do not provide unambiguous data, then there is no sense in which it is correct to say that Cohen's relationalism is opposed to our pre-theoretic intuitions. However, compared with 53.00% of Cohen and Nichols' participants, 72.30% of the current participants, and

75.00% for Not-Philpost, indicated agreement with anti-relationalism about color. Thus, my results suggest that things are not nearly as ambiguous as Cohen and Nichols' study would have us believe. In fact, my data suggests that anti-relationalism is clearly the pre-theoretically intuitive position.

As I said in the results section, only in Philpost were participants significantly less anti-relationalist about color than about shape. It is interesting to speculate about why this might be. Here is a thought. Perhaps philosophers are subject to something like a mere-exposure effect (for classic discussion of such effects see Zajonc, 1968). Philosophers may have more relationalist intuitions because they encounter the idea that colors are somehow less objective than shapes more frequently than the folk due to historical or sociological reasons. Starting with Galileo, Descartes, and Locke (amongst others) there has been an idea in philosophy that colors are (in some sense) less objective (or real) than shapes (Hacker, 1991). Locke is perhaps the most famous for this view. In the Essay he said, "Let not the Eyes see Light or Colors [...] and all Colors [...], as they are such particular *ideas*, vanish and Cease, and are reduced to their Causes, i.e. Bulk, Figure, and Motion of Parts" (1996, II-viii-17). At any rate, as I found that *only* in Philpost were participants less anti-relationalist about color than shape, it seems that it is not widely held amongst ordinary people that colors are less objective than shapes. This is of course compatible with colors being less objective than shapes, but it is a reason for caution: The intuitive position seems to be that colors are no less objective than shapes.

My results seem to suggest that some (27.70% all groups and 25.00% Not-Philpost) of my participants have relationalist intuitions about color. However, there is reason to doubt whether all those who selected the relationalist response (1-5 on *Target*)

were really expressing intuitions that accord with Cohen's relationalism as its main proponents understand it. Cohen has devoted the most ink to defending his view on color, and relationalism of Cohen's variety is an ecumenical view according to which if an object appears to be red, for instance, it has a property picked out by the English word "red", which for Cohen is a relational property (Cohen 2004; 2009, p. 24). However, I found a significant positive correlation between participants' answers to *Epistemic* and *Target*. In fact, in the color case, 17 out of 19 who disagreed with *Target* disagreed with *Epistemic*. So, there is some reason to doubt whether most of those who disagreed with *Target* can be said to be relationalists in Cohen's sense.

Cohen may respond to this by invoking his fine/coarse-grained distinction. As noted previously, coarse-grained colors, unlike fine-grained ones, are constituted by relations to normal observers and conditions so that with respect to these colors error can more easily occur. So, Cohen may try to appeal to his coarse-grained colors to explain why 17 out of 19 who disagreed with *Target* disagreed with *Epistemic*. Specifically, he may suggest that participants treat Alex and Harry as referring to coarse-grained colors. He may say that if Alex and Harry do so refer, at most one would be right, but it may be difficult (perhaps impossible) to determine which if either of them is right. In my opinion, the problem with this move is that, according to Cohen, coarse-grained colors are constituted by relations to normal observers and conditions, and the disagreeing parties in my case (Alex and Harry) are stipulated to be normal observers in typical (i.e. normal) conditions. Hence, it seems that Alex and Harry should both be right according to Cohen whether they are talking about fine-grained or coarse-grained colors. Thus, this response on behalf of Cohen does not look promising.

My curiosity about the correlation between *Target* and *Epistemic* prompted me to ask some of my participants to respond to an additional case after responding to the other items ($N = 62$, all Not-Philpost).⁷⁸ The cases are as follows:

Alex is correct when he says that the object is green [or cube-shaped], and in addition Harry is correct when he says the object is red [or round]. In other words, both Alex and Harry's claims are correct.

Participants in the color condition received the color version of this case and participants in the shape condition received the shape version. After reading the case, participants stated whether they disagreed or agreed with the following:

Above-True. The above statement is true.

Above-False. The above statement is false.

For both color and shape, participants largely disagreed with *Above-True* (color = 58.10%, shape = 80.60%) and agreed with *Above-False* (color = 64.50%, shape = 74.20%). Put another way, more people than not seem to find it intuitive that two color or shape ascriptions of properties that most philosophers deem incompatible cannot both be correct at the same time. The likelihood that shape and color responses are different was examined with the chi-square test. For *Above-True* the chi-square test is almost significant ($\chi^2(1, N = 62) = 3.72, p = 0.05$). This result suggests that people are more likely to agree that two observers can correctly ascribe color properties that most philosophers deem incompatible than they are likely to agree that two observers can

⁷⁸ This additional case was presented only to participants recruited in the second section through the University of Warwick (see footnote 8). The correlation between *Target* and *Epistemic* was first brought to my attention when considering the responses of participants in the first section.

correctly ascribe shape properties that most philosophers deem incompatible. However, it should be noted that for *Above-False* the differences did not approach significance.

These results are very intriguing when compared to my original results using *Target*. This statement is only about the color of the object and is not phrased so as to ask whether Alex and Harry's color ascriptions are correct. This is as it should be, because relationalism and anti-relationalism about color are metaphysical views on the nature of color and not views on how people use color terms. However, the new case was phrased so as to ask about Alex and Harry's color ascriptions, because I wanted to see whether most of those who disagreed with *Target* find it intuitive that at most one party is right. The difference in phrasing between *Target* and the new case allowed me to inadvertently discover something intriguing: When those in Not-Philpost are asked only about the colors of objects, their intuitions about color and shape are similar, but when asked about observers' color ascriptions, their color and shape intuitions seem to differ.

I explored this difference by looking at *Above-True*'s correlations with the seven original statements. For shape significant correlations appeared only between *Above-True* and *Target* and *Above-True* and *Epistemic* (respectively, $r = -0.38, p < 0.05$; $r = -0.41, p < 0.05$). This suggests that whether people find it intuitive that two observers can correctly ascribe to objects shape properties that most philosophers deem incompatible may be due to epistemic factors. For color no significant correlations emerged. I find this puzzling. Regardless, it does show that I cannot say that most of those who disagreed with *Target* in the color case find it intuitive that at most one party is right. With this being said, it certainly seems that I inadvertently discovered another reason to be worried about Cohen and Nichols' experiment: Their options (1)-(3) emphasized color

ascriptions, but I have shown that it cannot be assumed that how people answer questions about color ascriptions will map onto their answers about the colors of objects.

Relationalism and anti-relationalism are not views about language but about properties.

At this juncture it is important to consider some objections. One objection runs as follows: One could adopt relationalism about color as a solution to interpersonal, intrapersonal, or interspecies variation, or some combination of these types of variation, or all of these types of variation. The experiment I performed uses a case that involves interpersonal variation between Alex and Harry. Thus, as the objection goes, there is a worry that my experiment is only relevant to relationalism as a view designed to account for interpersonal variation. In reply, the crucial statement in the experiment, called *Target*, that I asked participants whether they agree with is as follows: In reality, there is an absolute fact of the matter about the color [or shape] of the object regardless of how it appears to Alex and Harry and regardless of what they think, say, or do. If one agrees with this statement, then it is unlikely that one finds it intuitive that the colors are constituted by relations to subjects, because by agreeing with the statement one is endorsing the claim that the color of the object is independent of how it appears to Alex and Harry and independent of what they think, say, or do. Thus, I think that that my experiment, regardless of how my case is stated, is relevant to all forms of relationalism defined as CR in section 1 of this chapter. I am happy to admit that a participant's agreeing with *Target* does not rule out his having intuitions that accord with relationalism in some broader sense.

Here is another potential objection. My opponent may grant that phenomenally-informed intuitions are a good guide when theorizing about color, but challenge the

assumption that *phenomenology* plays any significant role in informing my participants' responses. I can only think of two factors to which an opponent may appeal. They are as follows:

- (1) In a pilot study, I found that some participants appealed to quasi-scientific theories of color, e.g., red is a particular wavelength of light. Perhaps participants' responses were influenced by such a theory and not by their phenomenology.
- (2) In the same pilot study, some participants appealed to color-blindness cases. Perhaps those for whom such cases were salient distanced themselves from any influence of their own experience due to some sort of epistemic humility.

That is the best I can do, and I am prepared to be fairly flat-footed in response. The strong correlation between *Fault* and *Target* weighs heavily against (2) being a major influence. If drawn to anti-relationalism due to some sort of epistemic humility, one would not expect participants to agree that 'One of them, and possibly both, is at fault for getting the color wrong.' The fact that only a small number of participants (5/67) in the pilot explicitly appealed to quasi-scientific views weighs against (1).⁷⁹ It is possible that the number influenced (perhaps tacitly) by such views was really much higher. However, absent any concrete reason to think that this is the case, I am not worried. It seems plausible that when it comes to something as visual as color that for most people phenomenology would be the principal influence; when one thinks of a color it is the phenomenal character of that color that is foremost before one's mind.

Here is a third worry about my study. One may object that I should not ignore that

⁷⁹ The fraction 5/67 represents the proportion of participants who appealed to quasi-scientific views across three variants of a pilot study run in Autumn 2012.

a number of my participants (27.70% all groups and 25.00% Not-Philpost) indicated agreement with relationalism. The problem with this one may say is that I cannot be certain that the majority's responses, rather than the minority's, accurately indicate phenomenally-informed intuitions or even whether everyone's phenomenology is relevantly similar (Cohen and Nichols, 2010, p. 255-226). There are two objections here, one on either side of the disjunction. In reply to the former, I find it way more plausible that about 28% of my participants are failing to indicate phenomenally-informed intuitions than that about 72% are. As I said, it seems plausible when it comes to something as visual as color that for most people phenomenology would be the principal influence. So, absent an argument against this, I am not worried. Further, the fact that participants in Not-Philpost are just as (statistically) likely to be relationalist about color as about shape supports my claim that the minority are failing to indicate phenomenally-informed intuitions. Shapes very obviously appear non-relational.

In reply to the latter objection, I find it highly implausible that for some people the colors phenomenally appear relational and for others anti-relational. I suspect that everyone enjoys the same color phenomenology; that the 72% were accurately indicating phenomenally-informed intuitions, and that the 28% just did not understand the questions as intended and/or were theoretically biased in some way. However, it is possible that I am wrong. Maybe people really do have divergent color phenomenology. This is an empirical matter and one I would be incredibly interested to investigate, although I am not sure how to. If I *am* wrong, then that would be extremely interesting. It would raise all sorts of issues concerning the method of relying on phenomenally-informed intuitions. For example, if the colors really do phenomenally appear relational to some and anti-

relational to others, is one to infer that there are really two different types of color property, relational ones and non-relational ones? Notice that if that is what should be inferred, the whole debate between relationalists and anti-relationalists would be undermined; neither view admits the metaphysical possibility that both relational and non-relational colors exist. Regardless, the full repercussions of divergent phenomenology are not something I can explore here and has been assumed not to be the case in this essay.

I am confident, contrary to Cohen and Nichols, that anti-relationalism about color is in accordance with our phenomenally-informed, pre-theoretic intuitions and so is likely the correct view on color. One may worry that that such an inference supposes that being in accordance with our phenomenally-informed, pre-theoretic intuitions is evidence that anti-relationalism is true. However, as I noted, such a principle seems plausible *in the case of color*, as it flows from the idea that the phenomenal character of color experiences is an important guide as to the nature of the colors. It is open to my opponents to argue against the principle. This has not been done, and I cannot imagine it being done convincingly.

Summary of section 4

In this section, I concentrated on whether the introspective rejoinder against Cohen's relationalism has empirical support. Cohen and Nichols' (2010) experimental results suggest that almost half (47%) of their participants were relationalists about color. I noted a number of reasons to be worried about Cohen and Nichols' experimental design, and conducted a study of my own to address the concerns. Contrary to Cohen and Nichols'

results, my findings suggest that anti-relationalism is by far the most pre-theoretically intuitive position. Thus, my study supports that the introspective rejoinder is remarkably accurate about our intuitions.

Conclusion

Cohen's Relationism is roughly the view that the colors are relational properties like being married or being a sibling. The purpose of this chapter was to discuss the plausibility of this view. I had four principal aims. My first aim was to give a precise formulation of Cohen's view with which to work (section 1). My second aim was to argue that the color variation argument used to support Cohen's view is unconvincing (section 2). My third aim was to argue that Cohen's response to the objection that his view implies certain absurdities is incompatible with how he goes about motivating his view (section 3). My fourth aim was to defend the introspective rejoinder that Cohen's relationalism stands in stark contrast to our phenomenally-informed, pre-theoretic intuitions, and so should be rejected (section 4). Most generally, I have shown that Cohen's relationalism is unmotivated and has serious problems. Thus, I believe that the view is not in the least bit plausible and should be rejected.

Part 3.3: In Defense of Non-relational Primitivism

In this chapter, I shall argue that the colors are non-reducible and non-relational, categorical properties similar to what is true for the property of being square (Campbell, 1993; Hacker, 1991; Westphal, 2005; Yablo, 1995). I call this view, “non-relational primitivism.” There are two things I shall do in this chapter. First, I will present my positive argument for non-relational primitivism. Second, I shall defend non-relational primitivism from a battery of recent objections proposed mainly by Byrne and Hilbert but also by Hardin (section 2).

Section 1: Argument for Non-relational primitivism

In order to argue for non-relational primitivism I shall first argue that primitivism best captures our core beliefs about the colors and then I shall argue that non-relational primitivism is a better view than relational primitivism. What are our color beliefs about the colors? According to Johnston (1992, p. 222-223) the following constitutes our core beliefs:

- (1) *Paradigms*. Some of what we take to be paradigms of canary yellow things (i.e. some canaries) are canary yellow.
- (2) *Explanation*. The fact of a surface of volume or radiant source being canary yellow sometimes causally explains our visual experience as of canary yellow things.
- (3) *Unity*. Thanks to its nature and the nature of the other determinate shades, canary yellow, like the other shades, has its own unique place in the network of similarity, difference and exclusion relations exhibited by the whole family of

shades. (Think of the relations exemplified along the axes of hue, saturation and [lightness] in the so-called color solid. The color solid captures central facts about the colors, e.g. that canary yellow is not as similar to shades of blue as they are similar among themselves, i.e. that canary yellow is not a shade of blue.)

- (4) *Perceptual availability*. Justified belief about the canary yellowness of external things is available simply on the basis of visual perception. That is, if external things are canary yellow we are justified in believing that just on the basis of visual perception and the beliefs which inform it. (Further philosophical explication of this belief would come to something like this: If you are looking at a material object under what you take to be adequate conditions for perceiving its color and you take yourself to be an adequate perceiver of color then your visually acquired belief that material object is canary yellow is justified simply on the strength of (i) the information available in the relevant visual experience and (ii) those general background beliefs about the external causes of visual experiences which inform ordinary perception.)
- (5) *Revelation*. The intrinsic nature of canary yellow is fully revealed by a standard visual experience as of a canary yellow thing.

Revelation is an attempt by Johnston to capture a core belief about the colors that many philosophers have attempted to express. Here are two examples of such attempts.

"The particular shade of colour that I am seeing [...] may have many things to be said about it. [...] But such statements, though they make me know truths about the colour, do not make me know the colour it self better than I did before: so far as concerns

knowledge of the colour it self, as opposed to knowledge of truths about it, I know the colour perfectly and completely when I see it and no further knowledge of it itself is even theoretically possible.” (Russell, 1912, p. 47)

"Color words are words for properties which are of such a kind that their whole and essential nature as properties can be and is fully revealed in sensory quality experience given only the qualitative character that that experience has.” (Strawson, 1989, p. 224)

Revelation succeeds in *roughly* capturing the ideas expressed in these quotes. However, there are two interpretations of Revelation depending on how the word “revealed” is understood. I think that only one of them plausibly captures a core belief about color. The first interpretation understands “revealed” in a propositional sense. It is like seeing that or appearing that. Given this interpretation of “revealed,” Johnston’s Revelation can be expressed as follows:

Propositional Revelation (PR). It appears that p after careful reflection on our experiences as of the colors where p is about the nature of the colors iff p is true.

PR is the conjunction of the following two theses:

Infallibility: If it appears that p after careful reflection on our experiences as of the colors where p is about the nature of the colors, then p is true.

Self-Intimation: If a proposition p is about the nature of the colors and p is true, then it appears that p after careful reflection on our experiences as of the colors.

It is not uncommon for philosophers to interpret Revelation along the lines of PR (Byrne and Hilbert, 2007; Allen, 2011). However, it is doubtful that PR is a core belief about color. It is somewhat plausible that Infallibility is a core belief, because theories that are unable to accommodate what appears to be true about the nature of the colors after careful reflection (on our experiences as of the colors) are often taken to be false (Hardin, 1988; Boghossian & Velleman, 1991; Johnston, 1992). However, with regard to Self-Intimation, if it were true, then all truths about the nature of the colors would be revealed to us upon careful reflection on our experiences. Thus, it would be easy to discover what the colors are. We would need only to carefully reflect on our experiences and reject any view that was not revealed to be true. Things are not this easy and no one thought they would be. Investigation into the nature of color requires more than mere reflection on experience (Allen, 2011). Even the primitivist about color should admit that this is true. So, the interpretation of Revelation that understands “revealed” to be propositional revealing does not capture a core belief about the colors.

The second and better interpretation of Revelation is that the sense of “revealed” in this core belief is non propositional. When we have an experience as of Canary Yellow we do not experience *that* Canary Yellowness is whatever it is, but we do experience what it is. This talk of experiencing what Canary Yellowness is should not be understood propositionally. The idea is not that we see *that* Canary Yellowness is whatever it is. Rather the idea being expressed by ‘experience what it is’ is that we experience the entity that is identical with Canary Yellowness. Whatever Canary Yellowness is, we experience

it. According to this interpretation of “revealed,” the core belief can be expressed as follows:

Non-propositional Revelation (NR). We experience what the colors are (the entities that are the colors) in our visual experiences as of objects being colored.⁸⁰

NR captures the basic idea behind naïve realism in the philosophy of perception that our experience puts us into direct contact with the external world, and so has a strong claim to being a core belief about color. Also, NR avoids the issue with PR. NR says that whatever it is that Canary Yellowness is, we experience *it* in our visual experiences. NR does not say that whatever it is that Canary Yellowness is, it appears *that* Canary Yellowness is that thing. So, I believe that NR is the core belief that Johnston attempted to capture with his statement of Revelation.

Johnston’s list of core beliefs leaves out an important core belief. The missing belief is roughly that nothing can be red and green, yellow and orange, scarlet and sea green, or aquamarine and ruby, etc all over at once. This is such an intuitively true belief that it amazes me that Johnston did not include it on his list. That nothing can be red and green all over at the same time is usually used as an example of a synthetic a priori certainty to teach first year philosophy students the analytic/synthetic distinction.

⁸⁰ NR has an affinity with what Campbell (2005, Sect. 2) calls ‘transparency,’ which is the thesis that ‘experience of color provides knowledge of the categorical color property intervention on which changes the experiences of observers.’ The reason is that Campbell’s knowledge of the colors is not knowledge that certain propositions are true. Despite this similarity, Campbell’s Transparency is *obviously* different from NR. Most importantly, NR says we experience *the entities that are the colors*, while transparency is not similarly formulated: it does not say that experience gives us knowledge of the entities that are the colors. So, transparency is compatible with the colors being, for example, low-level physical properties, and Campbell agrees (2005, Sect. 2). Campbell thinks that it is transparency not PR that is a core belief about the colors. I do not wish to take issue with whether transparency is a core belief. I only wish to assert that NR is a core belief.

Although not explicitly called a core belief in the last chapter, the intuitively true belief in question was captured in that chapter as follows:

Incompatibility. No objects can be more than one determinable or determinate color all over at the same time.

Incompatibility should be understood as the sixth core belief about the colors and so added to the above list originally developed by Johnston. With this core belief stated, I have a clear and powerful list of core beliefs with which to argue for primitivism.

As I said, my argument for primitivism is that the view best captures our core beliefs about the colors. I cannot compare primitivism to every conceivable view on color. So, I shall instead compare primitivism to all the other views in my taxonomy in part 1.2: micro-structuralism, the disjunctive variant, Cohen's view, appearance dispositionalism, reflectance dispositionalism, and the type variant of this view. All these views can accommodate Paradigms, assuming they are taken to be realist.⁸¹ I think they can also all account for Explanation. What about well-known overdetermination arguments when it comes to this core belief? First, it is important to note that overdetermination arguments can be brought against any view on color that holds that the colors are realized by lower-level properties. So, overdetermination arguments can be brought against all the views being discussed except perhaps micro-structuralism. Second, I shall in the next section show how the non-relational primitivist can respond to overdetermination worries. What I say can be applied to the other views. All of these views but Cohen's can accommodate Incompatibility. I already argued in part 3.2 that

⁸¹ Reflectance dispositionalism, as stated, has an issue accommodating paradigms. Light is colored but its color does not come from reflecting incident light. This issue can be easily avoided by understanding "reflect" to just mean something like emit or transmit (Byrne and Hilbert, 2003). I understand the term in this broader way for the purposes of this paper. However, I will continue to use the word "reflect."

Cohen's view implies the falsity of Incompatibility, and that his attempt to address this odd consequence is incompatible with the motivation for his view. Thus, I shall not worry about which of these views can accommodate Paradigms, Explanation, and Incompatibility. Rather, I shall only consider which of these views can accommodate Unity, Perceptual Availability, and NR.

Let us first look at Unity. Primitivism can easily accommodate this core belief. The primitivist will just say that due to the primitive identity of Canary Yellow as revealed in experience and the primitive identity of the other colors as also so revealed, Canary Yellow necessarily stands in similarity, difference, and exclusion relations to all the other colors in the familiar color solid. This answer may not satisfy the desire for a deep, reductive explanation, but it shows that primitivism can accommodate Unity. This is all I care about here. Can the other views accommodate Unity? What about Micro-structuralism and the disjunctive variant of this view? There are at least 15 features at the micro-structural level that are sufficient to cause normal subjects in normal conditions to have an experience as of, for example, an object being sapphire blue: Incandescence, gas excitations, vibrations and rotations, transition metal compounds, charge transfer, metals, pure semiconductors, doped semiconductors, color centers, dispersive refraction, scattering, interference, and diffraction (Nassau, 1983; 1997). Can any of these features or disjunctions of them accommodate Unity? It certainly seems extremely doubtful.

What about reflectance dispositionalism and its type variant? In part 2.2, I argued that reflectance dispositionalism and its type variant cannot accommodate Unity using the modal argument from structure. This is the argument that reflectances (and types of reflectances) do not necessarily stand in the resemblance relations required to satisfy the

relevant core belief. The argument that this is true is quite simple. It is that upon examining the reflectance curves for R_b , R_p , and R_g , for example, we can see that there is no motivated means by which to hold that they stand in the appropriate similarity relations (and the same goes for types of reflectances). Take a look at figure 2.1. There is no way to justifiably and non-arbitrarily hold that the dotted line (the typical reflectance curve of blue objects) resembles the solid regular line (the curve for purple objects) more than it does the bold one (the curve for green objects). Thus, it seems very plausible that reflectance views cannot accommodate Unity. Of course, it is unsurprising that proponents of reflectance views have made attempts to accommodate Unity (Byrne and Hilbert, 2003, p. 15; Cohen, 2003, p. 88; 91-92). It is equally unsurprising that there are also those, including myself in part 2. 2, who argue that ultimately such attempts fail (Pautz, 2003; 2006). However, this debate is largely beside the point. All I need one to see is that primitivism can easily accommodate Unity, but that it is at best unclear whether reflectance views can do this and at worst extremely implausible that they can. If this is right, then it is reasonable to hold that primitivism does better with respect to Unity than reflectance views.

What about appearance dispositionalism and Cohen's view? I think that appearance dispositionalism can accommodate Unity. A proponent of this view can say that Canary Yellow is necessarily more similar to Auburn than to Scarlet in that the appearance of Canary Yellow that the disposition identical with this color is disposed to give is more similar to the appearance of Auburn that the disposition identical with being Auburn is disposed to give than to the appearance of Scarlet that the disposition identical with being Scarlet is disposed to give. Cohen's view on color can also accommodate

Unity. Roughly, Cohen's view is that the colors are constituted by relations that integrate objects and perceivers' experiences. So, proponents of this view can say that Canary Yellow is necessarily more similar to Auburn than to Scarlet in that perceivers' experiences as of Canary yellow, which are part of being Canary Yellow (in some logical sense), are more similar to perceivers' experiences as of Auburn, which are part of being Auburn (in this same sense), than perceivers' experiences as of Scarlet, which are part of being Scarlet (in the relevant sense). Thus, primitivism, appearance dispositionalism, and Cohen's view do a better job accounting for Unity than the other views.

Let us now look at Perceptual Availability. Primitivism can easily accommodate this core belief. The primitivist can say that external objects are actually colored and that we see the colors of objects in a very strong and direct sense. The primitivist can say that when we visually experience x being Canary Yellow, we are seeing the very entity that is Canary Yellow. This is sufficient to be justified in the Canary Yellowness of external things based simply on visual perception. Unlike primitivism, reflectance views, micro-structuralism, and the disjunctive variant of micro-structuralism are unable to accommodate Perceptual Availability. We are neither justified simply on the basis of visual perception in believing that objects have reflectance dispositions nor in believing that they have micro-structural properties. That objects have reflectance dispositions was a scientific discovery and so also was the fact that they have complex micro-structural properties. Hence, if reflectance dispositionalism or its type variant or micro-structuralism or its disjunctive variant were true, we would not be justified in believing that objects are colored simply based on visual perception. We would only be justified in believing that objects are colored after the scientific discovery that they have the relevant

properties (Jackson, 2012). Therefore, with respect to Perceptual Availability, primitivism is better off than these views on color.

Like any argument in philosophy responses are available. Friends of these views may try to reject the use of Leibniz' law in epistemic contexts. However, Leibniz law is a core metaphysical belief that is not understood to be context sensitive. So, this response forces its proponents to reject (or heavily modify) a core metaphysical belief in order to accommodate a core color belief, whereas there is no need for the primitivist to do this. One may also try to avoid the argument by rejecting the presupposition that what is required to be justified in believing that something has P is a property of P, but again this is a poor solution. Intuitively, what is required for justification in believing that something has P is a function of P. This is why physicists could infer from the standard model to the Higgs being such that E would be justification for believing in its instantiation, but it follows from this that the Higgs has the property of being such that E would be justification for believing in its instantiation (Jackson, 2012). Thus, the problem with the current response is that it commits proponents to rejecting the intuitive premise that what is required for justification in believing that something has P is a function of P, whereas there is no need for the primitivist to do this. Thus, it is clear that primitivism is better off with respect to Perceptual Availability than the relevant other views.

I have been arguing that primitivism is better off with respect to Perceptual Availability than reflectance dispositionalism, its type variant, micro-structuralism, and its disjunctive variant. What about the other two views? Based solely on the fact that objects appear colored (and the beliefs which inform perception) it is reasonable to hold that we can infer that they are disposed to appear colored. If this is right, then, if

appearance dispositionalism were true, we could be justified simply based on visual perception in believing that objects are colored. Cohen's view does not say what it is exactly that the colors are. All we can say is that according to Cohen's view the colors are reductive, relational properties that meet the analysis mentioned in parts 1.2 and 3.2. It is reasonable to think that such a view cannot accommodate Perceptual Availability. That objects have reductive, relational properties of the kind Cohen's view says the colors are would surely be a philosophical discovery. Thus, it seems that we are not justified in believing that objects have such relational properties simply based on perception.

This conclusion could be avoided if it could be shown that the beliefs which inform perception allow us to infer that objects have the relevant properties based on how they appear. Cohen's (2004; 2009) argument from perceptual variation for his view on color is much too philosophical for this. The argument requires the premise that "the best way to implement [...] an ecumenical reconciliation between apparently incompatible variants is to view them as the result of relativizing colors to different values of certain parameters, which is just to admit that the colors are relations between objects and those parameters" (Cohen, 2009, p. 24). Surely such a premise is not part of the beliefs which inform perception. In fact, Cohen's view on color seems to run against the beliefs which inform perception. His view, for example, has it that an experience as of a surface being green and an experience of that same surface being blue can both be right at the same time, but this runs against our common sense understanding of perceptual color disagreements. Thus, we can say that primitivism and appearance dispositionalism are better off than the other views with respect to Perceptual Availability.

I shall now consider NR. This core belief says that we experience what the colors are (the entities that are the colors) in our visual experiences as of objects being colored. The primitivist answers the question “what are the colors?” with the answer that they are the properties that we experience objects as having when having visual experiences as of objects being colored. Thus, the primitivist can easily accommodate NR. Reflectance dispositionalism, its type variant, micro-structuralism, its disjunctive variant, appearance dispositionalism, and Cohen’s view must all reject that we experience what the colors are in our visual experiences as of colored objects. All of these views are reductivist. To conclude, with respect to NR, we can say that color primitivism does better than all the other views. See table 3.2 for a comparison of the views.

	Primitivism	Reflectance Dispositionalism and the type variant	Micro- Structuralism and the disjunctive variant	Appearance Dispositionalism	Cohen’s View
Paradigms	1	1	1	1	1
Explanation	1	1	1	1	1
Unity	1	0	0	1	1
Perceptual Availability	1	0	0	1	0
Non-Prop. Revelation	1	0	0	0	0
Incompatibility	1	1	1	1	0
Total	6/6	3/6	3/6	5/6	3/6

Table 3.2. Comparison of the views

This table shows that reflectance dispositionalism, its type variant, micro-structuralism, its disjunctive variant, and Cohen’s view all do a poor job of accommodating our core beliefs. It is worth noting a few things. First, even if reflectance

views, micro-structuralism, and its disjunctive variant could accommodate Unity, these views would only score 4 out of 6. Second, even if Cohen's view could somehow accommodate perceptual availability, it would also only score 4 out of 6. Third, primitivism would still score better than the other views even if a point were subtracted from every view but micro-structuralism because of overdetermination worries with Explanation. Fourth, even if appearance dispositionalism could accommodate NR, it would at most follow that primitivism is on equal footing with appearance dispositionalism when it comes to satisfying our core beliefs. This would be sufficient for what I am trying to show. I am only attempting to show that primitivism must be taken seriously as a view on color. (It is important to note here that core beliefs are not all that is relevant to what the colors are. Even if appearance dispositionalism was on equal footing with primitivism, there may be other reasons to reject the view. In part 2.1 of this essay I argued against appearance dispositionalism, and in part 2.3 I argued against dispositional views in general. Also, regardless of whether primitivism best accounts for our core beliefs there may be overarching reasons to reject the view. I consider objections against primitivism in the next section.)

The way I see it is that primitivism is the only view on color discussed that can clearly accommodate all six of our core beliefs about the colors. This gives us an extremely good reason to take the view seriously when considering what the colors are. Moreover, given the troubles that other views have with accommodating our core beliefs, before realizing that primitivism is an option, one may think, like Johnston (1992), that we must be content with a view on what the colors are that merely accommodates most of our core beliefs as opposed to all of them. This is what Johnston (1992) calls speaking of

the colors “more or less inclusively” as opposed to speaking of the colors “ever so inclusively” (p. 221). In my opinion, there is no clear reason for us to hastily make such a sacrifice. Primitivism allows us to speak of the colors ever so inclusively. Thus, we cannot reject the possibility that there are colors ever so inclusively speaking until we have genuinely considered primitivism as a competing view.

So far I have shown that primitivism best accounts for our core beliefs. There are both relational and non-relational variations of primitivism. Which of these versions is best? I shall argue that non-relational primitivism is superior to relational primitivism, because the colors are not analyzable by the improved analysis of relational properties developed in part 1.2 of this essay. As I said in part 1.2, the improved analysis is as follows:

Improved analysis: A property P is relational iff there is some relation R such that it is essential to P that for all x , if x has P , then for some thing(s) $y_1...y_n$, $Rxy_1...y_n$

With this analysis in mind, my argument goes like this: If the property of being red were a relational property, then according to the analysis it would have to be essential to redness that if x is red, then for some thing(s) $y_1...y_n$, $Rxy_1...y_n$. However, it is a priori that redness does not meet this requirement. It does not seem essential to redness that if x is red, then for some thing(s) $y_1...y_n$, $Rxy_1...y_n$, and the same goes for the other colors. Hence, a priori we can reject that the colors are relational properties. They just do not meet the analysis.

Perhaps our intuitions on this matter could be overturned if there was a really good reason to accept that the colors are primitive relational properties. One may think

that the color variation argument provides the needed justification. As I said in part 3.2 of this essay, generally construed the variation argument can be presented as follows:

P1. There is no reason why one variant is veridical rather than another in X type (filled in with either interspecies, intrapersonal, or interpersonal) color variation cases.

P2. The best explanation of P1 is that Incompatibility, Realism, or Incompatibility and Objectivism is false.

3. Therefore, Incompatibility, Realism, or Incompatibility and Objectivism is false

Cohen (2004; 2009) uses an instance of this argument to support his relational view on color. Cohen believes that the best explanation of P1 is that Incompatibility and Objectivism are false and believes that the denial of these propositions is best captured by his view. So, presumably the primitivist could likewise say that the best explanation of P1 is that Incompatibility and Objectivism are false and that the denial of these propositions is best captured by a primitivist version of Cohen's view. I have no problem admitting that such a relational primitivism would better capture the denial of these propositions than Cohen's view. Primitivism unlike Cohen's reductive view can easily accommodate Perceptual Availability and Non-Propositional Revelation. Unfortunately, the argument from color variation fails to provide reason to accept any view on color, because, as I argued, the variation argument is unconvincing. Even if the argument were more convincing than it is, I have provided an empirical argument that the colors do not appear to be constituted by relations to subjects. So, this would seem to rule out

accepting a primitive version of Cohen's view. Finally, if the relational primitivist denies Incompatibility, he must accept that this view only scores 5 out of 6. Thus, using the variation argument to motivate a primitivist version of Cohen's view over non-relational primitivism would defeat the motivation for accepting primitivism over appearance dispositionalism.

Thus, we can conclude by saying that there is good reason to accept non-relational primitivism. I argued that primitivism is able to accommodate all our core beliefs about the colors. The only other view that comes close is appearance dispositionalism. However, I argued that appearance dispositionalism unlike primitivism is unable to accommodate Non-Propositional Revelation (NR). Thus, I said that there is a strong albeit defeasible reason to prefer primitivism to appearance dispositionalism. There are relational and non-relational variants of primitivism. I argued that the colors are not analyzable by the improved analysis of relational properties. A priori it does not seem essential to redness that if x is red, then for some thing(s) $y_1 \dots y_n$, $Rxy_1 \dots y_n$, and the same goes mutatis mutandis for the other colors. So, we should only hold that the colors are relational properties if there is very good reason to override our a priori intuitions. I argued that we do not have any such reason.

Section 2: Objections against non-relational primitivism

In this section, I want to discuss four recent objections to non-relational primitivism. The first is the objection from overdetermination (Hardin, 1988), the second is the objection from cosmic coincidence (Byrne and Hilbert, 2007b), the third is the objection from the falsity of Self-intimation (Byrne and Hilbert, 2007b), and the fourth is the objection from

animal color vision (Byrne and Hilbert, 2007b). In what follows I will consider these arguments in turn.

2. 1: The objection from overdetermination

The objection from overdetermination for non-relational primitivism (Hardin, 1988, p. 61) is analogous to the objection from overdetermination for the causal efficacy of mental properties in the philosophy of mind (Kim, 1993a; 1993b).⁸² So, the objection is not unique to non-relational primitivism. As such, the property dualist should not find the objection convincing for whatever reasons that he does not find overdetermination issues convincing in the philosophy of mind. Also, given the analogy, whatever is said in response to the overdetermination problem for non-relational primitivism is going to be relevant to overdetermination in the philosophy of mind, but I will only concentrate on color. With these things being said, the overdetermination objection is roughly that non-relational primitivism is incompatible with the colors being causally efficacious, because the colors' causal work is bizarrely overdetermined by the micro-structural properties upon which they supervene (nomologically or metaphysically). In other words, the

⁸² It is not abundantly clear what Hardin's objection is exactly. I am engaging with the objection under a plausible interpretation. This is what Hardin says: "But is there any reason to suppose that colors *are* among the elementary properties of bodies [i.e. that R-primitivism is true]? Consider: either the colors that Cornman supposes to attach to physical objects (call them *Cornman colors* or *C-colors* for short) are causally connected to the other physical properties of those objects or else they are not so connected. Suppose that they are, and that C-colors have physical effects. Then one ought to be able to test for their presence or absence by physical means, and a physical theory that makes no reference to them would be incomplete. But Cornman makes no claim to be remedying a deficiency in existing physical theories. So it seems that we must take C-colors either to be free of causal relations to an object's physical properties or else to be epiphenomena of some of them. In neither case will C-colors play a role in determining what wavelengths of light are emitted or reflected from or transmitted through the surface of a physical object...How, then, could they make any difference to our beliefs about colors?" (1993, 61)

overdetermination argument seeks to show that non-relational primitivism is unable to accommodate the second core belief about the colors called Explanation.

The overdetermination objection is as follows: Imagine four properties. The first is the property of being red (R), the second is the property of having an experience as of red (E), the third is the property of having some physical property (nomologically or metaphysically) sufficient for R (P_R), and the fourth is the property of being in some brain state (nomologically or metaphysically) sufficient for E (B_E). Science instructs us that P_R is a sufficient cause of B_E (in most normal human observers in normal circumstances) and also teaches us that B_E is at least nomologically sufficient for E (in most normal human observers in normal circumstances). So, given this scientific knowledge, we must hold that P_R is a sufficient cause of E. Unfortunately, R's causal work seems a priori to be that it is a sufficient cause of E, and the non-relational primitivist believes that R is a distinct property from P_R . Hence, the non-relational primitivist must admit that R's causal work is systematically overdetermined by P_R .

Unfortunately for the non-relational primitivist, as the argument goes, systematic overdetermination is weird and so ought not to be allowed. Why is systematic overdetermination so objectionable? Many philosophers seem to admit that it is unacceptable, but they disagree as to why. Let us look at three examples. First, Kim (1993a, p. 281) says that overdetermination is "absurd." Second, Melnyk (2003, p. 291) says that it involves an "intolerable coincidence." Third, Schiffer remarks, "it is hard to believe that God is such a bad engineer [that he would permit mass overdetermination]" (1987, p. 148). Whatever the correct reason is for overdetermination being objectionable, assuming it is, the non-relational primitivist should conclude that R is not a sufficient

cause of E. We know that R is causally sufficient for E. This is (more or less) a core belief after all. Thus, non-relational primitivism must be wrong about what the colors are.

2. 1. 2: Yablo's response

The strategy behind Yablo's (1992; 1995, p. 486-487) response to the overdetermination objection is effectively to try to provide some therapy for his opponents' discomfort with the causal overdetermination in cases like that above. Yablo thinks that if he can get the proponent of the overdetermination problem to see that systematic overdetermination is not so weird, then presumably he can get his opponent to believe that, for example, R's causal work being systematically overdetermined by P_R is not a reason to deny that R is causally efficacious. Yablo assumes that it is obvious that the overdetermination between determinates and their determinables is not objectionable, because determinables are (in some sense) part of their determinates. However, as Yablo's argument goes, the relationship between R and P_R (the supervenient/subvenient relation) is remarkably similar to the relationship between a determinable and its determinate. So, as Yablo says, as there is no problem with determinates overdetermining the causal powers of their determinables, by analogy, there should be no problem with P_R overdetermining R's causal powers.

A likely concern is to wonder why Yablo is so convinced that there is nothing objectionable about determinates overdetermining the causal powers of their determinables just because determinables are parts of their determinates (Kim, 1993, p. 362). The reason this concern must be taken seriously is that assuming Yablo's opposition accepts his analogy between the determinate/determinable and

subvenient/supervenient relation, he should say the following: The argument from overdetermination says that the systematic overdetermination between R and P_R is weird and thus ought not to be allowed. Generalizing from this, we ought not to allow supervenient properties to be causally efficacious. However, as Yablo has pointed out, the determinable/determinate relation is analogous to the supervenient/subvenient relation. Therefore, as the opposition's argument should go, by analogy, we should hold, contrary to what Yablo says, that determinable properties are not causally efficacious.

Thus, it is clear that in order for Yablo's treatment of the overdetermination problem to be convincing to his opponents he must provide an argument for his claim that the overdetermination of determinables by their determinates is not objectionable. What follows is the argument closest to the surface in Yablo (1995, p. 486-487): Imagine a scale that is designed to sound an alarm if an object placed on it weighs more than 70 pounds. The scale is constructed using a balance-beam so that it is insensitive to differences in the weight of objects over 70 pounds. Imagine that a 72 pound object is placed on the scale. The determinate property being 72 pounds and the determinable property being over 70 pounds are both causally sufficient (on earth) for the alarm's sounding. However, the property of being over 70 pounds is a better causal explanation of the alarm's sounding than the property of being 72 pounds in this case, because the alarm would have sounded as long as the object was over 70 pounds. If an object having a determinable property is sometimes a better causal explanation of an effect than its having a determinate of that determinable, then the systematic overdetermination between that determinate and its determinable is unobjectionable. All determinable properties are in certain circumstances better explanations of an effect than their

determinates. Therefore, the systematic overdetermination between determinates and their determinables is unobjectionable.

This argument is unconvincing. The reason is that the argument presupposes the premise that if a determinable is sometimes a better explanation of some effect than its determinate, then the systematic overdetermination between that determinate and its determinable is unobjectionable, but this premise is going to be rejected by the opposition. Those worried by Yablo's analogy about determinates overdetermining the causal powers of their determinables will admit that Tom's shirt being red would be a better explanation of the red hating robot vaporizing him than his shirt's being scarlet, but say that it is weird regardless that both Tom's shirt being red and its being scarlet are causally sufficient (given the appropriate circumstances) for the robot's vaporizing him. Therefore, I think that Yablo's response to the overdetermination problem is not going to be compelling to his opponents. Thus, I will not rely on Yablo's response to the overdetermination objection to defend non-relational primitivism. With this being said, it is important to note that I am not convinced that Yablo is wrong.

2. 1. 3: Watkins' response

Watkins (2002; see also 2005; 2010) draws on Yablo's (1995) view that the overdetermination between determinates and their determinables is unobjectionable, for determinable properties are (in some sense) part of their determinates. Watkins also relies heavily on the work of Shoemaker (1975; 1984; 1990; 1991; 1998). Roughly, Watkins' idea is that the overdetermination between R and P_R is not weird, because R's causal power is part of P_R 's power. Watkins' (2002) thinks that properties are nothing above

their causal powers. However, Watkins after conversation with Shoemaker appears to believe that his answer to the overdetermination problem might perhaps work regardless of this commitment (2002, p. 126). Below is my reconstruction of Watkins' (2002, p. 125) argument having taken out his commitment that properties are nothing above their causal powers.

P1. The causal powers contributed by R are (as a matter of nomological or metaphysical necessity) a subset of the causal powers contributed by P_R .

P2. The instantiation of P_R is (nomologically or metaphysically) sufficient for the instantiation of R.

P3. For any properties P and Q, if the instantiation of P is (nomologically or metaphysically) sufficient for the instantiation of Q, and if the set of causal powers contributed by Q is a proper subset of the powers contributed by P (as a matter of nomological or metaphysical necessity), then the overdetermination between P and Q is not weird.

(4). Therefore, overdetermination between P_R and R is not weird and so not objectionable, and mutatis mutandis for all other colors and their micro-physical realizers. (from P1-P3)

I believe that this argument fails at both P1 and P3. I shall not argue for why the argument fails at P1 at the moment, as the reason should become clear later in this chapter. Thus, for now I shall only look at why the above argument fails at P3.

I think the problem with P3 is that it begs the question against the proponent of the overdetermination objection. The reflective proponent of the overdetermination argument is going to believe that P3 is false, because he is sympathetic to both P1 and P2 yet rejects (4). Watkins' opponent already holds (P1) that the causal powers of R are a subset of the causal powers of P_R , and (P2) that P_R is sufficient for R. The rationale for (P2) is obvious. The fact that P_R is sufficient for R is clearly stated by the argument. The

rationale for (P1) takes a little more reflection. According to the overdetermination argument, an object having R is sufficient to cause E and the same for P_R . Moreover, according to the argument, P_R is also sufficient to cause B_E . Finally, the overdetermination argument says that R's causal work is that it is sufficient to cause E. Hence, it seems reasonable to assume that Watkins' opponent is sympathetic to both (P1) and (P2). However, despite the fact that Watkins' opponent seems to be sympathetic to both (P1) and (P2), he thinks that the overdetermination brought about by the relationship between R and P_R is weird and objectionable. Thus, it seems that Watkins' reflective opponent is going to believe that P3 is false priori to the argument under consideration being presented.

Why is it that Watkins (and Shoemaker?) thought that the above argument might perhaps work? The following is my diagnosis: Watkins says roughly that competition for causal efficacy between R and P_R arises only if the causal powers contributed by having R come from outside the powers contributed by P_R (2002, p. 117). The thought seems to just be Yablo's (1992; 1995) idea that the overdetermination between the causal powers of a whole and a part of that whole is not weird and so is unobjectionable. Hence, I imagine that Watkins implicitly thought that he could solve the overdetermination problem if he could show that R is part of P_R , because if this were true, then the causal powers contributed by having R would not come from outside the powers contributed by P_R . Rather, the powers would come from inside P_R so to speak. So, I think Watkins thought the relevant argument might work, because when he wrote this part of his book he was invalidly moving from the powers contributed by R being a subset of the powers contributed by P_R (P1) and P_R being sufficient for R (P2) to R being part of P_R .

We can understand why Watkins may have made this mistake if we look at the type of examples in his (1992) book. In this book, Watkins often uses examples involving properties that stand in a relationship similar to R and P_R and of which it is natural to think of as standing in a part/whole relation (in at least some sense). Watkins favorite example is one involving the properties of being cubical and having a polygonal side. Similarly to the relationship between R and P_R , the causal powers of having a polygonal side seem to be a subset of the causal powers of being cubical, and being cubical is sufficient for having a polygonal side. Thus, the explanation for Watkins' questionable move is probably that he was implicitly thinking that the above similarities between being cubical and having a polygonal side and P_R and R showed that R must be part of P_R just like how having a polygonal side is part of being cubical.

Can Watkins' implicit thoughts be used to show that R is part of P_R ? I do not think so. First, let us ask, "under what sense of 'part' is it natural to think of having a polygonal side as being part of the property being cubical?" It seems that the answer is that the relevant sense of 'part' is logical in nature; it is a conceptual truth that all square objects are polygonal ones. Thus, having answered this question, we can see that the analogy, if it were to succeed, would show that that R and P_R stand in a logical part/whole relation. However, a priori we can also see that R is not logically part of P_R , because it is conceptually coherent for an object to have R without it also having P_R . Of course, this may not be metaphysically possible, but this is irrelevant. Thus, Watkins' thoughts cannot be used to create an argument for P3. At the very least, I think a lot more would have to be said to make this convincing to his opponents.

Regardless of why Watkins thought the relevant argument might work, his solution to the overdetermination problem has some merit if we hold that properties are just sets of causal powers like he does. The reason for this is that if we make such an assumption, then it follows from R's causal powers being a subset of P_R 's to R being part of P_R in a set-theoretic sense. Unfortunately, any argument that requires the assumption that all properties are just sets of causal powers is not going to be convincing to the majority who believe there must be some categorical nature to objects (Ellis 2001; Molnar 2003). Any argument that makes the assumption is certainly not going to be convincing to me, because I accept the categorical/dispositional distinction. Thus, I cannot rely on Watkins' response to the overdetermination problem in order to defend non-relational primitivism.

2. 1. 4: My response

I will now present my response to the overdetermination problem. I said in section 2. 1 that philosophers disagree over why systematic overdetermination is objectionable. Kim (1993a, p. 281) says that overdetermination is objectionable, because it is "absurd." Melnyk (2003, p. 291) says that overdetermination is objectionable, because it involves an "intolerable coincidence." Schiffer (1987, p. 148) thinks overdetermination is objectionable, because "it is hard to believe that God is such a bad engineer [that he would permit mass overdetermination]." Kim's explanation is unclear. What exactly is supposed to be absurd about causal overdetermination? I do not see what the intolerable coincidence is supposed to be. Surely, if R and P_R both cause E, this is not due to a

coincidence, but follows from metaphysical and/or physical law. Thus, Melnyk's explanation is also unsatisfying.

Despite my being dissatisfied with both Kim and Lowe's explanations. I think that Schiffer is basically right. The reason why the overdetermination between R and P_R is objectionable is that its existence seems like it would imply a grave inefficiency in the causal workings of the world. In the overdetermination case in 2.1, P_R is sufficient for R , and it is implied that R does not add any causal powers not given by P_R . Hence, if the situation as described in 2.1 were to actually exist, then the world would appear to be such that any object with P_R has an additional property R that adds nothing to the causal mix. Thus, it would follow from the overdetermination case discussed in 2.1 that this world is vastly, causally inefficient. However, as Schiffer has pointed out, it seems that this world cannot possibly be so inefficient. Therefore, overdetermination like that suggested in 2.1 is objectionable.

There are two responses to the overdetermination argument given my understanding of what is objectionable about mass overdetermination. The first is to say that barring a belief in a god who cares about efficiency it is unobvious why this world should not be drastically inefficient. In other words, the first response is to reject that the overdetermination case is objectionable, because there is nothing problematic with the world being causally inefficient. This reply is going to be unconvincing to those who share the intuition that the world is not so inefficient. Moreover, inference to the best explanation (the principle that *ceteris paribus* we should choose the theory that has the best ratio of simplicity and explanatory power) would seem to favor a causally efficient world. The second response, and the one that I will now pursue in depth, is to argue that

the property being red (R) adds something to the causal picture. In other words, the second response is to reject that the overdetermination case is objectionable not because there is nothing objectionable about causal inefficiency but because the causal inefficiency suggested by the overdetermination argument does not really obtain.

Call the claim that R adds something to the causal mix, “Novel.” In order to show that Novel is true, it is important to differentiate between a property having a power simpliciter and a property having a power dependently. A property *P* has a power *Z* simpliciter iff an object’s having *P* is sufficient for its having *Z* independently of any other states of affairs. A property *P* has a power *Z* dependently iff an object’s having *P* is sufficient for it having *Z* only dependent on other states of affairs. For example, the disposition to break if dropped has the power to cause objects with it to break if dropped simpliciter, because an object with this disposition essentially implies that non-circularly if the object were dropped, then it would break (see part 2.3). However, the property of having a glass structure does not essentially imply any such counterfactual. Rather, this property only has the power to cause objects with it to break if dropped dependent on other states of affairs (e.g. the local gravitational force).

I will now argue for Novel. The overdetermination objection says that a priori R is sufficient to cause experiences as of red in most normal observers in normal conditions. However, R does not have this power simpliciter, because it does not imply the relevant counterfactual (see part 2.3). Rather, an object being R at time *t* implies that if one were to have a veridical experience as of *x* at *t*, then one would have an experience as of *x* being red at *t*. Veridical observers have veridical experiences. Thus, we can conclude that R is sufficient to cause simpliciter experiences as of red in veridical

observers. According to the non-relational primitivist, P_R is not identical with R , and an experience as of an object being red is veridical iff the object is red. So, it follows that according to non-relational primitivism P_R does not have the power to cause simpliciter experiences as of red in veridical observers. Thus, Novel follows, and so we can see that there is no causal inefficacy between R and P_R : In reality, R has a power that P_R does not have. Thus, the overdetermination problem can be solved. Moreover, we can say that there is no reason to be worried about primitivism and Explanation.

A likely concern is that my reply to the causal overdetermination problem is not compatible with the intuition that R is causally sufficient for experiences as of red in most normal observers in normal conditions. I must admit that it is my view that R is not sufficient to cause simpliciter experiences as of red in most normal observers in normal conditions. Nevertheless, R 's not being causally sufficient simpliciter for experiences as of red in such observers and conditions is compatible with R being causally sufficient for experiences as of red in such observers and conditions. R 's not being causally sufficient simpliciter for experiences as of red in most normal observers in normal conditions is compatible with R being sufficient to cause experiences as of red dependently in such observers and conditions. R is sufficient to cause experiences as of red in most normal observers in normal conditions dependent on P_R .

Another likely worry is that my view is incompatible with the causal closure of the physical, because it holds that R contributes a causal power not contributed by P_R (Kim, 1993). I do not think that this worry is well founded. My reasoning goes as follows: The theory-based conception of the physical that a property is physical iff it is the type of property that physics currently tells us about is much too narrow.

Contemporary physics is clearly not complete (Hempel, 1969). Moreover, many physicalists, for example, do not believe that mental properties are reducible to the types of properties in physics. So, we should reject the above theory-based conception of the physical. However, if we reject this conception, there is no obvious reason for holding that R is not a physical property. Thus, there is no clear reason to be worried about my view implying that causation is not closed under the physical.

2. 2: The objection from cosmic coincidence

The objection from cosmic coincidence (Byrne and Hilbert, 2007b, p. 96-99) is a dilemma for the primitivist about color not just the non-relational primitivist. However, I shall for simplicity assume that Byrne and Hilbert (B&H) are specifically targeting non-relational primitivism (and will do the same for the other objections against primitivism from B&H). It is also important to point out that the argument is supposed to be one against the realist version of primitivism. As it is only this version that can accommodate Paradigms, what I call “primitivism” in this section should be understood as realist primitivism. Some further stage setting is required. According to B&H (2007b), primitivism can be divided into nomological coextensive primitivism and metaphysical coextensive primitivism. Generally construed, nomological coextensiveness and metaphysical coextensiveness can be defined respectively as follows:

Nomological Coextensiveness (NC): For any color c , there is a reflectance type P such that c is nomologically coextensive with P.

Metaphysical Coextensiveness (MC): For any color c , there is a reflectance type P such that c is necessarily coextensive with P.

I assume that the reflectance type P is defined in terms of the color c such that the type of reflectance properties that constitute P are those (nomologically or metaphysically) sufficient for c . However, whether this is what B&H intend is unclear.

With the above distinction in mind, the argument from cosmic coincidence is roughly that the primitivist is committed to the NC variant, but this variant commits one to an objectionable pre-established harmony or cosmic coincidence. B&H's argument for why the primitivist is committed to the NC variant is as follows: It is simply that *the* motivation for primitivism is that the connection between colors and reflectance types seems metaphysically contingent, so the primitivist must accept NC primitivism. So, the primitivist must accept the NC variant or undermine the motivation for this view on color.

Why do B&H think that the NC variant commits one to an objectionable pre-established harmony or cosmic coincidence? The answer involves a thought experiment. Imagine two possible worlds w_1 and w_2 that are as close to the actual world as possible given the ways in which they differ. On w_1 the reflectance types coextensive with the colors are sufficient to cause experiences as of the colors for which they are nomologically coextensive. So, for example, on w_1 the reflectance type R^{red} is nomologically coextensive with redness, and the reflectance type R^{yellow} is nomologically coextensive with yellowness, and so on. Unlike on w_1 , on w_2 the reflectance types coextensive with the colors are such that they are sufficient to cause experiences as of colors other than the ones for which they are nomologically coextensive. So, for example, on w_2 , unlike w_1 , the reflectance type R^{red} is nomologically coextensive with yellowness, and the reflectance type R^{yellow} is nomologically coextensive with the redness, and so on

for all the colors. The differences between these two worlds can be captured using the below conceptual aid, see figure 3.4.

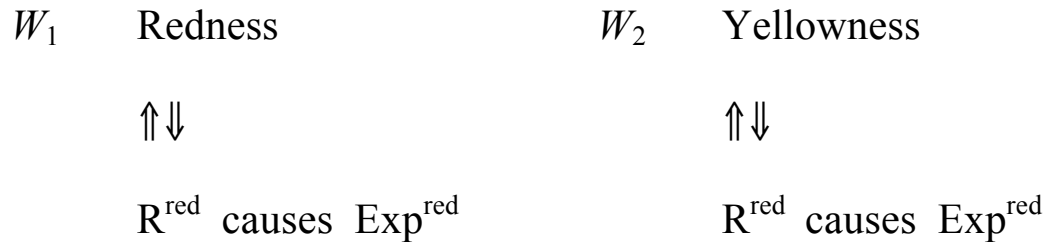


Figure 3.4. The two worlds

B&H's argument is as follows: According to the NC variant, both w_1 and w_2 are metaphysically possible. World w_1 is one in which its inhabitants see the colors of objects veridically, because the reflectance types coextensive with the colors in this world cause experiences as of colors for which they are coextensive. The inhabitants of w_2 are not so lucky, because on w_2 the reflectance types coextensive with the colors cause experiences as of colors other than the ones for which they are coextensive. Thus, the residents of w_2 never see the colors veridically. Primitivism (as I have defined it for this section) holds that we see the colors veridically. According to NC primitivism, it is metaphysically possible that we are on a world like w_2 instead of one like w_1 . Thus, the NC primitivist must hold that by a pre-established harmony or cosmic coincidence (a.k.a. chance) we are on a world like w_1 rather than one like w_2 . However, as B&H say, it is neither acceptable to appeal to a pre-established harmony nor to a cosmic coincidence to explain why we are in a world like w_1 . The above could also be stated as an argument that primitivism cannot accommodate Paradigms.

2. 2. 1: *Why B&H's cosmic coincidence argument cannot succeed.*

The objection from cosmic coincidence cannot succeed. With respect to B&H's argument for why the non-relational primitivist is committed to the NC variant, I agree that *a* motivation for primitivism is that the connection between colors and reflectance types seems metaphysically contingent. It seems metaphysically possible for there to be a world in which an object has R^{red} but is not red. However, I disagree that this is the *only* motivation for primitivism. My argument for primitivism is that this view best accounts for our core beliefs about color. This argument does not depend on the metaphysical possibility of reflectances and colors coming apart. Thus, the primitivist is not committed to the NC variant. So, The primitivist can accept the MC variant and thus accommodate Paradigms.

Regardless, as B&H's argument that the NC variant commits the primitivist to a cosmic coincidence cannot succeed, the NC variant is also available. B&H's argument against the NC variant befalls a serious dilemma. On one horn, something's being metaphysically possible does not imply that we must appeal to chance or cosmic coincidence to explain why the possibility does not actually obtain. It is metaphysically possible that I could become the president of the United States, but there is no need to appeal to chance or cosmic coincidence to explain why this possibility will never actually obtain. On the other horn, if B&H were to reject this, then their argument would threaten to over generalize. Many things are metaphysically possible. Therefore, if something's being metaphysically possible implies the need to appeal to chance or cosmic coincidence, then it is going to be required that we appeal to chance or cosmic coincidence to explain quite a lot of things.

2. 2. 2: *An epistemological reply*

B&H say that their argument that the NC variant commits one to a cosmic coincidence or pre-established harmony should be understood metaphysically. As I have shown, the argument fails utterly under this interpretation. However, an epistemic version would avoid my above repudiation. The epistemic interpretation is as follows: Assume that NC non-relational primitivism is true. It follows from this that the actual world may be like w_2 . If our experience gives us knowledge as to the color of objects, we know that we are not in a world like w_2 . However, worlds like w_1 and w_2 would give rise to qualitatively indistinguishable experiences. Hence, we have no reason to believe that the actual world is like w_1 rather than w_2 . Thus, given NC non-relational primitivism, our experiences as of color fail to provide us with epistemic access to the colors of objects. Contrary to what NC non-relational primitivism implies, our experiences as of color do give us epistemic access to the colors of objects. Thus, NC non-relational primitivism is false.⁸³ A similar argument could perhaps be used to show that non-relational primitivism cannot accommodate the core belief about color called Explanation.

I do not think that this epistemic interpretation of B&H's argument can succeed. Let me explain. There is nothing in the epistemic reasoning used in the argument that differs from that used in skeptical arguments against knowledge of the external world. Consider the following analogous argument using the same kind of epistemic reasoning:

Possibly, there is a world w_{BIV} that is distinct from what we naively believe to be the actual world in that objects never are the way they appear, because the people of w_{BIV} are brains in vats (BIVs). If our experiences give us epistemic access to

⁸³ This epistemic argument is close to the surface in Allen (2011), but he uses it to argue that the colors have their causal powers essentially. Given the similarities, what I say here should address Allen's argument.

the external world, we know that we are not BIVs and so not in w_{BIV} . The experiences of a BIV are indistinguishable from those of a normal human being. Hence, we do not know that we are not in w_{BIV} . Thus, we have no knowledge of the external world.

The analogy between the epistemic interpretation of B&H's argument and the above skeptical argument shows two things. First, it shows that non-skeptics cannot endorse the epistemic interpretation of B&H's argument. The second thing that the analogy shows us is that the non-relational primitivist can use any of the well-known responses to skepticism about the external world to defend themselves against the epistemic interpretation of B&H's argument. Answers to skepticism about the external world are divisible into incompatibilist and compatibilist responses. The incompatibilist holds that ordinary knowledge of the external world and skepticism are in conflict. The compatibilist holds that ordinary knowledge and skepticism are in harmony. Incompatibilism comes in skeptical and dogmatic variants. In the former skepticism is successful, and in the latter ordinary knowledge is victorious. Compatibilism is divisible into anti-closure and contextualist versions. The former holds that ordinary knowledge coexists with skeptical doubt within the same knowledge relation, and the latter holds that they coexist in different knowledge relations referred to in disparate contexts.

Perhaps the non-relational primitivist prefers incompatibilism. Incompatibilist skepticism is not a viable option for the non-relational primitivist, but he may accept dogmatism. Dogmatism is divisible into at least three forms, deductionism, direct realism, and abductionism. The first is the view that we can know that skeptical situations do not actually obtain by reasoning through the closure inference (Klein, 1981). As a

deductionist, the non-relational primitivist response to the epistemological argument is that the knowledge that we have hands is sufficient to show that we know the colors of objects. The second view is that we can know skeptical scenarios do not actually obtain by perceiving the external world directly (Brewer, 1999). The primitivist response, as a direct realist, is that we know the true colors of objects, because we perceive them directly. This option should be especially attractive to the primitivist, as direct realism about perception and primitivism about color are well suited to each other. The third view is that we can know that skeptical scenarios do not actually obtain via an inference to the best explanation (Vogel, 1990). The abductionist, non-relational primitivist response is that all skeptical scenarios are inferior explanations of appearance and so should be rejected.

Perhaps the non-relational primitivist prefers compatibilism of the anti-closure form. This form is divisible into anti-closure relevantism, anti-closure tracking, and anti-closure reliabilism. The first variant is that one can fail to know that $\sim q$ for some q that implies $\sim p$ but know that p , because q is not a relevant substitute to p (Dretske, 1970; 1981). As an anti-closure relevantist, the non-relational primitivist response is that we can fail to know that skeptical scenarios do not obtain but know that objects are colored, because skeptical scenarios are not relevant alternatives. The second variant is that one can fail to know that $\sim q$ for some q that implies $\sim p$ but know that p if one can track its truth to the nearest world in which $\sim p$ is true (Nozick, 1981). As an anti-closure tracking theorist, the non-relational primitivist should say that we know objects are colored regardless of whether we know that skeptical scenarios obtain, because we can follow this truth to the nearest world in which it is false. The third version is that one can fail to know that $\sim q$ for some q that implies $\sim p$ but know that p , because one came to believe p

via a reliable process (Goldman, 1979; Heller, 1999). The non-relational primitivist, as an anti-closure reliabilist, will say we know that objects are colored despite not knowing whether skeptical scenarios obtain, because our perceptual systems are, in fact, generally reliable.

Perhaps the non-relational primitivist likes the contextualist form of compatibilism. The contextualist holds that one can fail to know that $\sim q$ for some q that implies $\sim p$ but know that p , because q is not relevant given the context (Cohen, 1988; 1999; DeRose, 1995; Lewis, 1996). For example, the contextualist holds that given every-day contexts one can know that one has hands. It is only during philosophical discussions of skepticism that this knowledge is undermined. As a contextualist, the non-relational primitivist response is that ordinarily we know that the world is colored regardless of the fact that we fail to know whether skeptical scenarios obtain, because skeptical scenarios are not relevant in ordinary, every-day contexts. So, from what I have shown thus far, one can see that basically any response to skepticism about the external world can be applied to B&H's argument interpreted epistemically. This consequence should hardly be surprising, because the colors are merely one feature of the external world.

2. 3: The objection from the falsity of Self-Intimation

There is an argument close to the surface in B&H (2007b, p. 79-81) against non-relational primitivism that I shall call 'the argument from the falsity of Self-Intimation.' Although B&H stop short of explicitly calling what they say an argument against primitivism, it is clear that they think what they say is worrying for the view. I shall for

readability talk as if the argument is in fact B&H's.⁸⁴ Before I can explain the argument from the falsity of Self-Intimation, it is first necessary that I remind my reader of what is called "Revelation." Revelation I said can be interpreted as Propositional Revelation or Non-Propositional Revelation. Propositional Revelation is that it appears that p after careful reflection on our experiences as of the colors where p is about the nature of the colors iff p is true. Propositional Revelation is divisible into two halves. The first half, called "Infallibility," says that if a proposition p appears to be in the nature of the colors after careful reflection on our experiences as of the colors, then p is true. The second half,

⁸⁴ Given the complexity of B&H's argument, here are the passages where the argument from the falsity of self-intimation is close to the surface. "Minimal Primitivism may be further explicated by the claim that the colors have no non-chromatic nature, in the following sense: if 'It is in the nature of the colors that p ' is true, then ' p ' is a purely chromatic sentence-- a sentence that is (at least) solely composed of topic neutral and color vocabulary. [...]"

Let Q be the (true) proposition that it is in the nature of the colors that p . (Since Q is true, it is also true that p .) If all such propositions seem true after careful reflection on color experience, then Self-Intimation follows. Assume that Minimal Primitivism is true, and hence that ' p ' is purely chromatic.

Suppose that Q does not seem true after reflection on color experience. There are two cases: (i) either Q does not seem true because $\sim Q$ seems true, or (ii) neither Q nor $\sim Q$ seem true--color experience is silent on whether Q is true.

Case (i) is ruled out by the assumption of Infallibility. Supposedly, 'It seems not to be in the nature of the colors that p ' is true. What sentences α are such that 'It seems not to be in the nature of the colors that α ' is true? Almost any sentence: it seems not to be in the nature of the colors that tomatoes are red, that tomatoes are fruits, that it's raining, that it's not raining,.... But, given Minimal Primitivism, ' p ' is purely chromatic, which narrows the field considerably: it seems not to be in the nature of the colors that every shade of orange is greenish, that canary yellow is a shade of blue, and so forth. Since (we may grant) it seems to be in the nature of the colors that no shade of orange is greenish, that canary yellow is not a shade of blue (etc.), by Infallibility it is in the nature of the colors that no shade of orange is greenish (etc.). Plausibly, given Infallibility, if 'It seems not to be in the nature of the colors that p ' is true, and ' p ' is purely chromatic, then ' p ' is *false*. But, since by hypothesis ' p ' is true, case (i) is ruled out.

That leaves case (ii). Could careful reflection on color experience fail to deliver a verdict on whether it is in the nature of the colors that p (where ' p ' is purely chromatic)? For example, might reflection leave one undecided whether it is in the nature of the colors that blue is the hue that is brightest at maximum saturation, or whether red₁₇ (a very fine grained shade) is more similar to purple₉₃ than to purple₉₄? At any rate if we idealize the "careful reflection", the relevant range of color experience, and the subject's powers of discrimination, there is some initial plausibility to the view that a verdict (right or wrong) would be forthcoming--call this Completeness. With that assumption, case (ii) is also ruled out. We may conclude that--vagueness and unclarity aside--Minimal Primitivism, Infallibility, and Completeness entail Self-Intimation." (2007b, p. 79-81)

known as “Self-intimation,” says that if a proposition p is in the nature of the colors, then p seems true upon careful reflection on our experiences as of the colors.

With Propositional Revelation in mind, what follows, presented in premise-conclusion form because of its complexity, is the argument from the falsity of Self-Intimation:

P1. Assume that non-relational primitivism is true.

P2. Non-relational primitivism can be understood as the view that if a proposition p is in the nature of the colors, then p is expressible only using a purely chromatic sentence. (Examples of purely chromatic sentences include: ‘Every shade of orange is reddish’, ‘Canary yellow is not a shade of blue’, ‘Purple is more similar to red than to yellow’, and so on.)

P3. Let Q be a true proposition, expressible by only purely chromatic sentences, that p is in the nature of the colors.

P4. All Q type propositions seem true after careful reflection.

P5. Self-Intimation is false.

(6). It is in the nature of the colors that if a proposition p is in the nature of the colors, then p is expressible only using a purely chromatic sentence. (from P1, P2)

(7). If all Q type propositions seem true after careful reflection, then Self-intimation is true. (from P3, (6))

(8). Self-intimation is true. (From P4, (7))

(9). Non-relational primitivism is false. (From P5, (8))

I agree with B&H that Self-Intimation is false. The idea that all truths about the colors are apparent upon careful reflection on our experiences as of the colors is absurd. B&H are

free to define a Q proposition in P3, and step (8) follows from P4 and (6). Nevertheless, in what follows I will provide three separate arguments against P2, step (7), and P4 respectively.

2. 3. 1: Why the self-intimation objection cannot succeed

Why does B&H's argument fail at P2? The reason is that non-relational primitivism, at least as I have defined the view, is the theory that the colors are non-reducible and non-relational, categorical properties of objects, and this is a truth about the nature of the colors that is not specifiable in purely chromatic terms. In other words, that the colors are non-reducible and non-relational, categorical properties is not a truth about the nature of the colors that is specifiable by sentences like "every shade of orange is reddish", "Canary yellow is not a shade of blue", "Purple is more similar to red than to yellow," etc. So, P2 is false. That is, it is false that non-relational primitivism can be comprehended as the view that if a proposition p is in the nature of the colors, then p is expressible only using a purely chromatic sentence.

A likely worry is that but for the proposition that the colors are non-reducible and non-relational, categorical properties it seems that P2 is true. So, assuming that B&H's argument is otherwise sound, we can get that non-relational primitivism implies something close to Self-intimation and is this not objectionable? In reply, the variant of Self-intimation that excludes the proposition that the colors are non-reducible and non-relational categorical properties avoids the absurdities of the original. My argument is as follows: The modified Self-intimation excludes the proposition that non-relational primitivism is true. So, the modified Self-intimation cannot be used to accept non-

relational primitivism directly. Moreover, it must be impossible to use the modified version to establish non-relational primitivism by rejecting the other views. After all, if this could be done, it would follow that if non-relational primitivism is true, then non-relational primitivism appears true after careful reflection. So, the modified version of Self-intimation must be compatible with disagreement regarding views on color that do not appear to be true simply after careful reflection on our experiences as of the colors. As what is worrying about Self-intimation is that it allows one to rule out any view on color that does not appear true after careful reflection on our experiences as of the colors, this consequence shows that the modified Self-intimation avoids what is worrying about the original.

Why does B&H's argument fail at step (7)? For the move to (7) to be valid, it must be that all true propositions about the nature of the colors are expressible in purely chromatic language. Step (6) is supposed to give one this, because it says that it is in the nature of the colors that if a proposition p is in the nature of the colors, then p is expressible only using a purely chromatic sentence. However, (6) cannot do what is needed, because (6) is in the nature of the colors yet is not expressible by a purely chromatic sentence. An obvious way to avoid this issue is to change (6) so that it is not a claim about the nature of the colors, but B&H cannot do this. B&H must hold that (6) is a claim about the nature of the colors, because their reason for holding it is that they think that non-relational primitivism is the view that if a proposition p is in the nature of the colors, then p is expressible only using a purely chromatic sentence.

B&H may try to avoid my objection by changing the definition of Self-intimation so that it excludes (6). Recall that (6) says that it is in the nature of the colors that if a

proposition p is in the nature of the colors, then p is expressible only using a purely chromatic sentence. Unfortunately, like with the attempt to modify Self-intimation to avoid my argument against step P2, this modified version of self-intimation avoids the problems with the original. The modified version excludes (6). So, it must be impossible to use this modified Self-intimation to accept non-relational primitivism as understood by B&H directly. Moreover, it must be impossible to accept non-relational primitivism (as understood by B&H) indirectly by rejecting the other views. If we could do this, then it would be true that if (6) is true of the colors, then (6) appears true after careful reflection. Hence, one must be unable to use the variant of Self-intimation that excludes (6) to rule out views that do not appear true after careful reflection on our experiences. Thus, the modified Self-intimation avoids the issues of the original.

Now I want to show why P4 is implausible. P4 is that all Q type propositions seem true after careful reflection. A Q type proposition is a true proposition about the nature of the colors that is only expressible in purely chromatic terms. So, assuming P4 is true, any proposition that says something is true of the nature of the colors and is only expressible in purely chromatic terms must seem true after careful reflection.

Unfortunately this is implausible. Colors like unique red, unique yellow, unique green, and unique blue (unitary colors) have been thought by certain people (Berkeley, 1708-9; Goethe 1810, Brentano, 1907; Hering, 1920) to appear in some sense essentially uncomposed, whereas all the other colors (the binary colors) have been thought by these same people to appear in some sense to be essentially composed out of other colors.

However, despite many supporting this unitary/binary distinction, well-known psychologists including Kulpe, Titchener, and Ebbinghaus have denied that any colors

appear to be essentially composed (Allen, 2011, p. 164-165). As those on both sides are respectable scientists and philosophers, it is implausible that they have failed to carefully reflect on their experiences. Thus, the claim that all Q type propositions seem true after careful reflection is implausible.

2. 4: The objection from animal color vision

The objection from animal color vision can be found in B&H (2007b, p. 94-95). What follows is an interpretation of B&H's argument designed to fit in with past things said in this essay.⁸⁵ The argument from animal color vision is similar to the dilemma argument for the first premise of the metaphysical, interspecies instance of the variation argument discussed in part 3.2. As I mentioned in that chapter, it has been empirically shown that

⁸⁵ As the argument is complicated, I am including here B&H's original words for my readers. "Human beings are not the only animals with color vision. Consider, for example, the common goldfish (*Carassius auratus*). [...] How should the R-primitivist describe the discriminatory abilities of the goldfish? One natural and well-motivated description is that goldfish really are responding to colors, albeit not those that human beings can detect. It is unclear, though, whether the R-primitivist can agree, because the claim that goldfish are responding to colors is in some tension with Revelation. If there are goldfish colors, then presumably they have some nature in common with the human variety. The nature of the human colors, then, should somehow make room for goldfish colors. But careful reflection on (human) color experience seems, if anything, to exclude the possibility of colors that are not located within the familiar color solid. That is, if the nature of the human colors is revealed to us by color experience, as Revelation claims, then (arguably) goldfish colors do not exist. [...]"

One alternative description is that both human beings and goldfish are responding to the same range of colors but that one group--let it be the latter!-- is prone to systematic errors in color discrimination. [...] This view suffers from two related problems. First, the explanation of why one species is right and the other wrong is left incurably mysterious. Second--setting aside the comparison with humans--convicting goldfish of error is not very well motivated, because they are responding to objects in a way that correlates with real physical differences. Of course, humans are not sensitive to these differences, but they are there nonetheless.

There is one other option available to the R-primitivist [...]. On this view, although goldfish are perhaps detecting genuine properties of objects, these are not colors. [...] This view comes in two versions. On the first, each non-human species with so-called "color vision" perceives a family of properties ("c-properties") idiosyncratic to that species. [...] This version implausibly supposes that different types of animals use very similar physiological machinery, sensitive to very similar types of environmental features, to detect unrelated properties. On the second version, human beings see primitive colors, while non-human animals merely perceive physical features (reflectance types, say) of objects in their environment. On both versions of the third option, as with the second, it is mysterious how to motivate and justify the special treatment of human beings." (2007b, p. 94-95)

non-human animals differ from us in the construction of their visual systems. For example, the eyes of (typical) goldfish, ducks, and pigeons contain four retinal receptor types. However, (typical) human eyes contain just three retinal receptor types. Hence, goldfish, ducks, and pigeons have what is called “tetrachromatic vision,” while humans have what is called “trichromatic vision.” This difference in visual systems results in its taking four appropriately chosen spectral lights for goldfish, ducks, and pigeons to perceptually match any given spectral stimulus (in standard conditions), and its taking three spectral lights for humans to perceptually match any given spectral stimulus (in standard conditions) (Jacobs, 1981; Thompson, 1995, p. 141-160).

The objection from animal color vision rests on the following dilemma: Imagine three spectral lights L that perceptually match a spectral stimulus S for humans but not for goldfish. That is, the lights appear the same in respect to some determinate color to humans but do not appear the same in some respect to the goldfish. Now, the question is whether the goldfish or the humans’ perceptions of the match are veridical. There are four plausible answers to consider, which are as follows: (I) The goldfish and humans’ perceptions of L are both veridical, but different types of properties are represented by their experiences. The human represents L as having a color y , and the goldfish represents L as having a color* z (which is not a color). (II) The goldfish’ perceptions of L veridically represent its color, but the humans’ perceptions falsidically represent its color or vice versa. (III) The color of L is neither veridically represented by the humans nor by the goldfish. (IV) The goldfish and humans’ perceptions of L are both veridical, and their experiences both represent color properties. The human represents L as having a color y , and the goldfish represents L as having a color z .

With this dilemma in mind, the objection from animal color vision is as follows: Option (I) is objectionable, because it is mysterious why goldfish would represent different properties from humans given that their visual systems are so physiologically similar. (II) is objectionable, because it seems that we would be unjustified in saying that either the goldfish or the humans but not both perceive veridically, because both species are responding to objects in ways that correlate with physical differences. (III) is objectionable, because it seems we typically see the colors of objects veridically. A color realist must accept this. Given that (I)-(III) are objectionable, the only plausible option left is (IV). However, the non-relational primitivist cannot accept (IV). Thus, non-relational primitivism should be rejected.

Why is it that the primitivist cannot accept (IV)? The idea seems to be that the primitivist is committed to Revelation and that this core belief excludes the possibility of colors not located in the familiar color solid. The variant of Revelation relevant to B&H's argument is Propositional Revelation. I rejected this as a core belief above. The primitivist is only committed to Non-Propositional Revelation. This likely avoids the argument, because Non-Propositional Revelation does not imply anything about what propositions appear true of the colors after careful reflection.⁸⁶ Putting this aside, I think that by using Propositional Revelation, specifically the half called "Infallibility," one can develop an argument that appears sound. Infallibility =df if a proposition p seems to be in the nature of the colors after careful reflection, then p is true. After careful reflection it seems that Closed is true of the colors. What I am calling "Closed" here is the claim that the familiar color solid is a closed space, because the solid spatially represents internal

⁸⁶ In fact, Campbell (2005; see also Allen, 2011) has defended primitivism from B&H by denying that the primitivist is committed to what I call "Propositional Revelation."

relations of similarity and difference (Allen, 2009; Westphal, 1987 p. 125). Hence, as the argument goes, the non-relational primitivist is committed to Closed. If there are colors that we cannot see, then Closed is false. Call this, ‘Complete.’ Option (IV) implies that there are colors that we cannot see. Thus, the non-relational primitivist cannot accept (IV).

2. 4. 1: Why the animal color vision objection cannot succeed

Closed follows from Unity. Unity is a core belief about the colors. Moreover, the fact that the non-relational primitivist can account for this core belief was advertised above as an advantage of the view. Thus, the non-relational primitivist should not reject Closed.

However, the non-relational primitivist can reject Complete. This premise presupposes that if there are colors that we cannot see, these colors would have to be introduced to the familiar color solid. It is this introduction that would undermine Closed. The non-relational primitivist, however, can reject this presupposition for reasons similar to those discussed in part 3.2. There are two options here for the non-relational primitivist. Option (IV) A is to say that there are colors that we cannot perceive that are already in the solid and so do not need to be introduced. Option (IV) B is to say that there are colors that we cannot perceive that are not in the familiar color solid at all.

The non-relational primitivist can choose (IV) B by accepting Allen’s (2009) view on interspecies variation. Allen (2009) says that the goldfish and humans’ perceptions of *L* are veridical and represent determinate color properties located in goldfish color space. These colors vary over different dimensions of determination from the three (hue, saturation, and lightness) that our colors vary over. As a consequence of

this, the colors that goldfish see are *not* internally related to the colors that we see with respect to these dimensions. Personally, as a non-relational primitivist I would be hesitant to choose (IV) B, because I find it conceptually problematic. I can no better understand there being colors that do not vary of hue, saturation, and lightness than I can understand shapes that do not vary over number of sides, length of sides, etc. With this being said, the point of this section is not to argue against Allen's view on interspecies variation. Perhaps there are grounds for calling certain properties colors even though they do not vary over hue, saturation, and lightness (Allen, 2009, p. 214-219), but I cannot discuss this here.

The non-relational primitivist can choose (IV) A by saying that the goldfish represent more finely grained colors of the kind located in the familiar color solid than humans and *L* instantiates such properties, as described in part 3.2 of this essay. For example, perhaps goldfish veridically represent super-determinate colors. Super-determinate colors would stand to the determinate colors the way the determinate colors stand to the determinable ones. Thus, super-determinate colors would vary over the same dimensions of determination as the colors that we see and would be internally related to them with respect to hue, saturation, and lightness. However, super-determinable colors would not need to be slotted into the familiar color solid. They would exist "underneath" the determinate colors like the determinate colors are "underneath" the determinables. So, for example, a super-determinate of scarlet would not need to be slotted in next to scarlet but would exist "underneath" scarlet like scarlet is "under" red.

As I have shown, there are two ways that the non-relational primitivist can accept (IV). However, is (IV) really the best option to the dilemma like B&H say? I suspect that

the reality of the situation is that we have no a priori reason to prefer (IV) over (I). In reality it is probably that for some animals (IV) A is the best option, for others (IV) B (assuming the conceptual issues can be sorted out), and for others (I). One could only justifiably choose one of these options over the other two for any particular species after extensive empirical investigation into its visual system. B&H disagree. They clearly think that (I) is inferior to (IV) A and B on a priori grounds. They think that option (I) is inferior, because they think it is implausible that goldfish would represent different properties from humans given that their visual systems are so physiologically similar.

As I mentioned in part 3.2 of this essay, this argument against (I) presupposes the premise that if a (functioning) visual system Q is similar in design to a (functioning) color representing visual system U , then Q probably also represents color properties, but one cannot make this inference. Doing so ignores that the differences between Q and U likely have some impact on the properties that they represent. So, to say that Q represents color properties, one needs to know that the ways in which Q differs from R are irrelevant to whether it represents colors. Alas, with regard to non-human animal visual systems like those of goldfish it is unclear whether this is the case (Thompson, 1995; Hardin, 1988; see also Watkins, 1999; 2002). Hardin (1988, p. 150-152), for example, makes it explicit that we should not assume that the neurological differences between human and non-humans are irrelevant to seeing the colors. So, at most my opponent can use the premise that if a (functioning) visual system Q is similar in design to a (functioning) color representing visual system U , then Q probably represents properties at least similar in kind to the colors. However, this premise, unlike the presupposition, fails to show (I) is

implausible, because (I) is compatible with it being the case that goldfish represent colors* that are *similar* in kind to the colors but not the *same* in kind.

Conclusion

I argued in this chapter that the colors are non-reducible and non-relational, categorical properties similar to what is true for the property of being square. I called this view, “non-relational primitivism.” First, I presented my positive argument for non-relational primitivism. Second, I defended non-relational primitivism from a battery of recent objections proposed mainly by Byrne and Hilbert but also by Hardin (section 2). Thus, most generally I have shown that non-relational primitivism is an excellent view on color.

Part 4: Should we be Realists?

The colors are non-relational and non-reducible, categorical properties, but are these properties actually instantiated by external objects? In part 3.2, I defended realism indirectly by showing that no instance of the color variation argument can succeed because this form of argument has also been used to support irrealism. In part 4, I will further defend realism by refuting the argument from mass disagreement.

Part 4.1: Against The Argument from Mass Disagreement

The argument from mass disagreement is roughly that the best explanation of there being mass perceptual disagreement about the colors of objects is that irrealism is true (section 1). Why should one accept that there is mass perceptual disagreement about the colors of objects? One motivation is that the claim is supported by the empirical literature. The secondary motivation comes from a philosophical argument based on evolutionary speculation. I argue that the empirical literature does not support there being mass perceptual disagreement about the colors of objects (section 2), and that the evolutionary argument fails (section 3).

Section 1: The irrealist argument

Before I can present the irrealist argument, it is necessary for me to define some terms. P-Disagreement =df There is mass perceptual disagreement about the colors.

Incompatibility =df No object can be two or more different determinate or determinable colors all over at the same time. Objectivism =df the colors are mind-independent properties. Veridicality =df typical observers' color experiences represent the colors veridically in typical daylight conditions.

I do not know of any particularly clear statement of the argument from mass disagreement, but it is close to surface in the work of certain irrealist sympathizers.

Broadly construed the argument can be presented as follows:

- P1. P-Disagreement is true.
- P2. Objectivism and Incompatibility are true.
- P3. The best explanation of Veridicality being false is that irrealism is true.

(4). So, either Objectivism or Incompatibility is false, or Veridicality is false.

(From P1)

(5). Hence, Veridicality is false. (From 4, P2)

(6). Therefore, irrealism is probably true (Hardin, 1988; 2004; Mclaughlin, 2003; Chalmers, 2006). (From 5, P3)

The irrealist argument is valid. I have argued that the colors are non-relational properties. So, I cannot hold that they are mind-dependent. I believe that Incompatibility is true and have defended it elsewhere. In what follows I will question the truth of P1.

Section 2: P-disagreement empirically supported?⁸⁷

Does the empirical literature really support P-Disagreement? Allen (2010b) has questioned whether P-Disagreement is really supported by the empirical literature. Allen points out that the amount of disagreement measured by experiments depends on many methodological factors, including but not limited to the participants' native language (Berlin & Kay, 1969), age (Scheffrin & Werner, 1990), and retinal illuminance (*Ayama et al.*, 1987). Moreover, Allen argues that the amount of disagreement is highly affected by the particular color(s) studied, with unique green causing the most disagreement. Thus, when analyzing multiple studies it is important to remember that disagreement will arise not only due to participants' color perception but also due to many methodological differences between the studies (*Ayama et al.*, 1987; Kuehni, 2004).

⁸⁷ This section is the result of collaboration with Kelly Schmidtke (a research fellow at Warwick) who helped me run the experiment in 2.1. The ideas culminated in a published article in *Review of Philosophy and Psychology*. Please see Roberts & Schmidtke (2012). The final publication is also available online at <http://www.springerlink.com/content/g587787114328685/>.

I admire Allen's attempt to bring some needed scrutiny to whether the empirical literature really supports P-Disagreement. However, one plausibly confounding factor that most philosophers including Allen have overlooked is task type.⁸⁸ In this section, I argue that the type of task employed in most empirical studies that appear to support P-Disagreement calls this support into question. Broadly speaking, there are two types of tasks used in the empirical literature, matching and naming tasks.

Matching Tasks =df An experimental procedure in which participants are presented with at least two colored examples and asked whether they look the same or different.

Naming Tasks =df An experimental procedure in which participants are presented with colored example(s) and asked to name them.

Naming tasks depend on participants' having concepts of the particular colors (color concepts) associated with color words, while matching tasks do not so depend. Naming tasks require participants to say, for instance, which example is best described by a certain color term (e.g. 'unique red'). So, in order for participants to complete a naming task, they must have a color concept associated with the given color word. In contrast to naming tasks, matching tasks only require participants to be able to say whether colored examples look the same or different. Hence, in order to complete a matching task, participants are not required to have, for instance, a color concept associated with the word 'unique red.' Of course, we admit that matching tasks require concepts. Matching and naming tasks require, amongst others, both the concept of something being colored and the concept of something being the same or different. Our claim is merely that

⁸⁸ Byrne and Hilbert (2007a, footnote 5) mention that task type is important but other than this example I am unaware of any philosophers who have talked about task type in relation to P-Disagreement.

matching tasks do not depend on participants having color concepts associated with color words, while naming tasks do so depend (Jordan & Mollon, 1994).

Philosophers use empirical studies to support P-Disagreement. An overview of the literature reveals that the majority of the studies that appear to support P-Disagreement use naming tasks not matching ones (see Allen 2010b for a review). Let us look at the tasks used by a few of them. Perhaps the most widely recognized large-scale color research is the World Color Survey (Cook, Kay & Reigier, 2011).⁸⁹ In this research, participants are first presented with various differently colored chips one at a time and for each chip asked what basic color term best describes it. In a later task, participants are shown all the differently colored chips at once and asked to say which chip is best described by a given color term. Although not part of the World Color Survey, Wuerger, Atkinson, and Cropper (2005) use a similar task. In their task, participants are given a color term and then view 12 differently colored circles on a computer. After selecting the colored circle that is best described by the given color term, the computer presents 12 colored circles that give off a narrower range of wavelengths from which the participant again selects the best example for the given color term.

In other researchers' naming tasks, the wavelengths that cause experiences as of the unique colors are determined by presenting participants with colored examples and asking whether they contain too much of a neighboring color to be a unique color. For example, when measuring unique green, participants see a green-ish color and say whether it contains too much blue or yellow to be unique green. If the participant says, for instance, that the example contains too much blue, then the experimenter adjusts the

⁸⁹ One may argue that the world color study deals with focal colors, not unique colors. This discrepancy is not problematic to our claims as Miyahara (2003) found that participants' mean focal colors and unique hues were strikingly similar for red, green, blue and yellow.

color by reducing the example's blueness. This process repeats for a pre-determined number of trials or until the participant indicates that the example is unique green (Scheffrin & Werner, 1990; Malkoc et al., 2005, Unique Hue Settings; Webster et al., 2000). It is important to note that many experiments that do not consist entirely of naming tasks have a naming task component. For example, Ayama et al. (1987) asked participants to *name* unique color examples at different illuminances. Then participants were presented with a new color example and asked to *match* this new color with their previously chosen unique colors at different illuminances.

I suspect that the additional conceptual factor in naming tasks (the color concepts participants associate with color words) is responsible for a lot of the empirically measured disagreement that appears to support P-Disagreement. Thus, I expect results based on naming tasks to vary considerably more across participants than the results of matching ones. My hypothesis implies that conceptual factors not perceptual ones explain a notable amount of the empirically measured variation. P-Disagreement is the proposition that there is mass *perceptual* disagreement about the colors of objects amongst human observers in typical conditions. Thus, if our hypothesis is correct, then P-Disagreement is in a precarious position. Without strong empirical support, we ought to seriously question whether P-Disagreement is true, as the premise is in conflict with common sense. According to common sense there is little perceptual disagreement amongst most human observers in typical conditions.

My aim in calling P-Disagreement into question is to provide a defense of Incompatibility, Objectivism, and Veridicality from the empirically based form of argument under consideration. A defense of these propositions is an attack against

selectionism, relationism, and eliminativism. This is because selectionism (the view that our visual systems select different properties to be the colors) implies that Incompatibility is false (Allen, 2009a; Kalderon, 2007; Mizrahi, 2007); relationism (the view that the colors are relational properties that combine objects and perceivers) implies that Objectivism is false (Cohen, 2004; 2006a; 2007; 2009), and eliminativism (the view that external objects are not colored) implies that Veridicality is false (Boghossian and Velleman, 1989; Chalmers, 2006; Hardin, 1988; Maund, 1995; and Pautz, 2006).⁹⁰ Moreover, a defense of the relevant propositions is also a defense of primitivism (the view that the colors are non-reducible properties) and physicalism (the view that the colors are properties like those mentioned in modern physics), with my preferred view obviously being non-relational primitivism. The reason for this is that both primitivism (Campbell, 1993; Westphal, 1987; 2005; Watkins, 2002; 2005) and physicalism (Byrne & Hilbert, 2003a) (as often conceived) are species of realism and objectivism about color.

2.1: The experiment

I ran an experiment to test my hypothesis that the relevant conceptual factor is responsible for a lot of the empirically measured variation. In a classroom lit with Philips Master 26W/840/P4 bulbs, 24 philosophy students (19 male) at the University of Nottingham voluntarily participated in my study to understand visual color disagreement,

⁹⁰ Some believe that dispositionalism is a form of relationalism (for example see Cohen, 2009). For the purposes of this chapter, I understand relationalism to be incompatible with dispositionalism, because relationalism but not dispositionalism is the denial of Objectivism.

none of who acknowledged having any color deficiency.⁹¹ Each participant received two worksheets: half the participants received a green matching worksheet and a red naming worksheet, while the other half were given a red matching worksheet and a green naming worksheet. Participants could modify the angle they viewed the sheets from as they desired. The order of the worksheets and the items within the worksheets were counterbalanced across participants, and no order effects emerged.

The colored items were constructed using Microsoft Publisher's CMYK color index.⁹² Unique green and unique red were defined so that CMYK for green = 100.0.100.36 and CMYK for red = 0.100.100.20.⁹³ The worksheets were printed using a professional grade color printer, run by a professional print shop, called 'The Xerox 700 Digital Color Press,' which has received the FOGRA Validation Print Certification measuring color accuracy and consistency.

Both the matching and naming worksheets contained 20 pairs of items (see figure 4.1, but keep in mind that the color accuracy will depend on the monitor or printer used).

⁹¹ A likely concern is to worry about the fluorescent lighting used in the room in which we conducted our experiment. Since we were concerned with comparing disagreement in the naming task with disagreement in the matching one, the only reason to be worried about the lighting would be if there were good reasons to suspect that it differentially affected our tasks. However, not only are our results for each task independently predicted by the psychophysical data (see p. 8-11), but also our pilot experiment conducted in natural daylight found comparable results (see p. 12).

⁹² The letters in the initialism 'CMYK' stand for Cyan, Magenta, Yellow, and Black respectively.

⁹³ The black ink was added so as to decrease the lightness and prevent the items from appearing washed out. The green items needed more black ink than the red ones to obtain this goal.



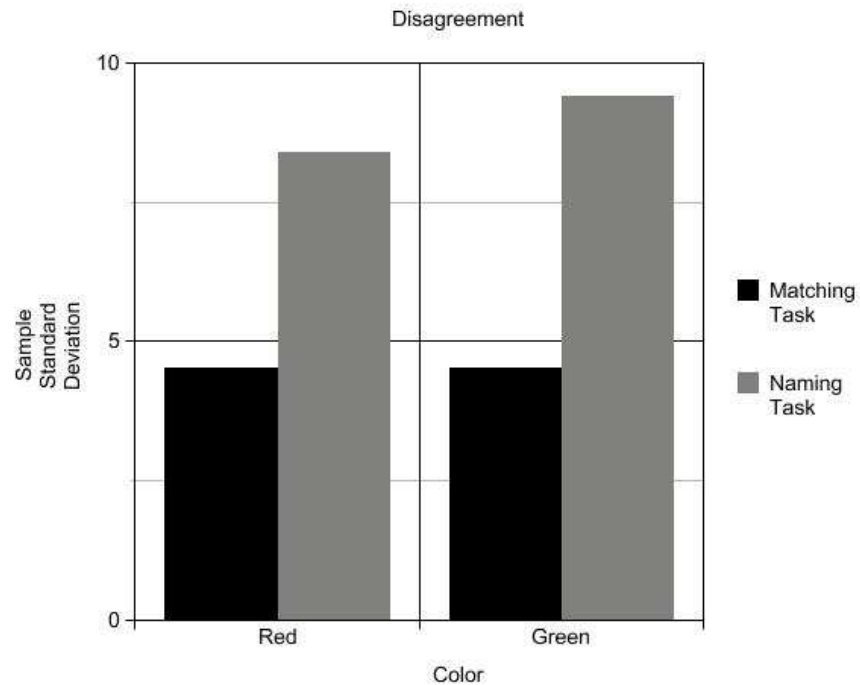
Figure 4.1. Examples of worksheets

Each pair contained a standard item positioned left of a comparison item. The standard items on the matching worksheets were rectangles colored to exemplify unique green or unique red. In contrast, the standard items on the naming worksheets were the words “True Green” or “True Red.”⁹⁴ The comparison items for both worksheets were colored rectangles. Only one of the comparisons matched the standard. The remaining 19 comparisons differed from the standard in that they contained different amounts of cyan, magenta, or yellow by 5 unit steps. Instructions on the top of both worksheets read,

⁹⁴ We used the terms “True Green” and “True Red,” because it is our understanding that these terms in the vernacular mean what “unique green” and “unique red” mean respectively to color scientists. We defined “true green” and “true red” for our participants in the same way that “unique green” and “unique red” are defined in color science.

“Circle the box that contains the same items.” The instructions were also verbally explained. I explicitly told participants that they were only to circle one pair for the matching task and one pair for the naming task.

After checking that my participants followed the directions correctly, their responses were entered into analyses as the number of units that their chosen comparison differed from the standard. The standard deviation was highest for the green naming worksheet ($SD = 9.41$), followed by the red naming worksheet ($SD = 8.38$), and lastly the green and red matching worksheets, which both had the same standard deviation ($SD = 4.52$), see figure 4.2. The Brown-Forsythe test for equality of variances was selected to compare these groups, as this test has greater power than other tests designed to compare variance with non-normal distributions (Conover, Johnson & Johnson, 1981; Algina, Olejnik, & Ocanto, 1989). These tests revealed that the naming worksheets produced more disagreement than the matching worksheets ($F(1, 46) = 7.93, p < 0.01$). This difference was significant for the green worksheets ($F(1, 22) = 6.06, p < 0.02$) but not the red worksheets ($F(1, 22) = 2.37, p > 0.05$). There was no significant difference between the green and red matching worksheets, and no significant difference between the green and red naming works.



s.

Figure 4.2. Standard deviations across participants. Standard Deviations (SD) for the red and green matching and naming worksheets across participants. A significant difference appears between matching and naming tasks. The difference remains when green matching and naming tasks are compared but does not remain when red matching and naming tasks are compared. No significant difference appeared between the matching worksheets or between the naming worksheets.

2.2: Discussion

The results show that significantly more interpersonal disagreement emerges in naming than matching tasks. So, the results should cast doubt on whether P-Disagreement is true by supporting my hypothesis that the additional conceptual factor in naming tasks (the color concepts participants associate with color words) accounts for a lot of the empirically measured variation. P-Disagreement implies that at least one of the propositions Incompatibility, Objectivism, or Veridicality is false. Thus, by showing that P-Disagreement is in trouble, I have provided a defense of these three propositions about

the colors. A defense of the relevant propositions is an attack against selectionism, relationalism, and eliminativism as well as support for physicalism and primitivism.

A competing hypothesis that would support P-Disagreement is that my results are explained by widespread color transformations rather than the relevant conceptual factors. There are three (approximate) reflectional symmetries in color space that would allow for three transformations all of which would be largely if not completely undetectable: red-green inversion, blue-yellow and black-white inversion, and complete inversion (Palmer, 1999). If these three inversions were distributed amongst the population, then there would be mass perceptual disagreement about the colors of objects but no reason to suspect increased disagreement about whether they look the same or different. Thus, if these three inversions were distributed amongst us, it may seem that there would be more disagreement in naming tasks than matching ones, and this is exactly what we find. My opponent may have similar expectations for at least some of the behaviorally detectable transformations.

Whether color transformations (behaviorally detectable or not) are widespread is an important question, but I do not think that they can explain the results of the experiment. The argument is as follows: One would associate different color concepts with color words dependent on how one's color space was transformed. For example, someone who was red-green inverted would associate the concept of being green with the word 'red' and the concept of being red with the word 'green,' and so, despite the inversion in how things phenomenally look, he would verbally agree with the non-inverted that, for instance, the forest is green and that fire trucks are red. In naming tasks, participants are presented with colored sample(s) and asked to name them. One can only

name the relevant examples using one's color words. Thus, inversions in color space cannot explain why I found more disagreement in the naming task than the matching task. Of course, if one believes that such inversions obtain based on other grounds, one is going to be unconvinced by our experiment that P-Disagreement is in trouble. Regardless, the results support my conceptual hypothesis and not the color transformation one.

Another worry is that I only found that naming tasks result in significantly more disagreement than matching ones with respect to unique green. It is my opinion that this finding is sufficient to call P-Disagreement into question. A review of the empirical literature (Allen, 2010b) reveals that disagreement primarily occurs with respect to unique green, while significantly less disagreement emerges with other unique colors. For example, Kuehni (2004) reviewed 10 color experiments, and found that the variation with unique green (*Mdn* Range = 62 nm) was larger than both unique blue (*Mdn* Range = 21.5 nm) and unique yellow (*Mdn* Range = 9 nm).⁹⁵ Using Munsell chips, The World Color Survey supports the same pattern, with the most variation arising with green (*VAR* = 3.01 chips) then blue (*VAR* = 2.45 chips), red (*VAR* = 0.46 chips) and finally yellow (*VAR* = 0.31 chips) (Webster & Kay, 2005). Therefore, supporting my hypothesis with respect to unique green is sufficient to call P-Disagreement into question.

A third concern is that matching tasks also suggest disagreement, and so is the disagreement measured using these tasks not enough to support P-Disagreement? While matching tasks do produce disagreement, the disagreement is dramatically less than that

⁹⁵ The largest exception to this general pattern is Ayama et al. (1987). The small number of participants ($N = 2$) in Ayama et al.'s experiment can explain the observed deviation, because such small numbers of participants likely make variation larger. Also, it is interesting to note the absence of data available for unique red in Ayama et al.'s experiment. Unique red is a non-spectral color and the tasks compared by Ayama et al. all use spectral stimuli.

in naming tasks, as evidenced by the present experiment as well as many others. One frequently used matching task is the Rayleigh match. In this task, participants view a split stimulus where the first half emits a combination of wavelengths (e.g. green + red) and the second half emits a single wavelength (e.g. yellow). The participant then adjusts the light waves emitted by the first half so that it matches the second half. The researcher then records the percentage of red light in the first stimulus so that the scores range from 0 to 1. It has been found that participants' mean Rayleigh matches vary little across (from $M = 0.547$ to 0.555) and within experiments (from $SD = 0.021$ to 0.037) (Lutze et al., 1990, Table 5).

In other research using matching tasks, it was found that people with clinically defined normal color vision can distinguish between wavelengths of 1 nm at the middle of the spectrum where green is located (500 and 600 nm). People's ability to distinguish wavelengths does degrade to about 6 nm at the ends of the spectrum where violet and red are located (Wright & Pitt, 1934), but recall that an nm is only one billionth of a meter. Of course, people with color deficient vision vary more in color perception tasks than those with normal color vision (Barbur, 2008), but only a small minority of the population (about 4%) have color deficiencies. Thus, while matching tasks do suggest disagreement, the disagreement is not nearly as much as naming tasks suggest and certainly not sufficient to support P-Disagreement. On the contrary, the results of matching tasks are what we would expect if P-Disagreement were false.

I pointed out in the introduction to section 2 that Ayama et al's (1987) experiment includes a matching component, and so this study's results are important to addressing the present concern about matching tasks. In support of Incompatibility, Objectivism, and

Veridicality, the results were that participants demonstrated a spectacular ability to match new colors with previously chosen ones. The location of unique colors did change with retinal illuminance for both tasks but never so much as to cause disagreement about unique colors (e.g. examples identified as unique blue were never identified as unique green). The disagreement that was measured by Ayama et al. must be cautiously considered. First, the experiment included a naming task component and so is susceptible to my general worry about using such tasks to support P-Disagreement. Second, like many color studies this experiment included a small number of participants ($N = 2$), and studies that use such small numbers of participants are insufficient to provide more than a modicum of support for P-Disagreement.

A final concern may result from wondering about the impact that the large-scale disagreement evidenced by naming tasks has on P-Disagreement. In reply, P-Disagreement is that there is mass *perceptual* disagreement about the colors of objects amongst human observers in typical conditions. The experiment suggests that the additional factor in naming tasks (the color concepts participants' associate with color words) accounts for a lot of the empirically measured variation. Hence, in order to support P-Disagreement using naming tasks, it must be that the color concepts we associate with color words affects the colors that our visual systems represent, but it is unclear whether the relevant factor can do what is required. In fact, whether this factor can influence what our visual systems represent touches on contentious issues relevant to the debate about perceptual content (McDowell, 1994; Tye, 2000) and cognitive penetration (Raftopoulos, 2005; Macpherson, 2012).⁹⁶ Thus, although the disagreement

⁹⁶ One reason to be suspicious as to whether the relevant factor can influence what our perceptual systems represent is that it would seem that how the colors phenomenally look to people does not change based on

evidenced by naming tasks is relevant to the debate about P-Disagreement, the relevance has no impact on my argument to the effect that P-Disagreement is in an unstable position.

Why is there a significant difference between the green naming and matching worksheets but not one between the red naming and matching worksheets? I believe that this result is best explained by the participants associating either (1) a larger number of relatively narrow concepts with the word ‘unique green’ or (2) one or more broader concepts with ‘unique green.’⁹⁷ If (1) were true, this would mean that the question being considered is primarily explained by there being more disagreement between people about which concept is associated with the word ‘unique green’ than there is about which concept is associated with ‘unique red.’ If (2) were true, this would mean that the question is mostly explained by there being many more greens that satisfy the concept people associate with the word ‘unique green’ than reds that satisfy the concept people associate with ‘unique red.’

An alternative explanation is that the participants’ concepts were comparable, but that they had less plausible examples of unique red from which to choose than unique green. Some of the examples on the red worksheet look orange to me, while all the examples on the green worksheet look green. I do not think that this alternative

their concepts of the particular colors. Here is an argument: Assume that how the colors phenomenally look changes based on peoples’ concepts of them. Necessarily, if two experiences E1 and E2 differ in phenomenal character, then they differ in representational content (Representationalism). So, we get that when someone first forms a concept of a color like aquamarine, he comes to represent something new. However, the correct view of what is happening when someone first forms the concept of a color like aquamarine is that he has come to have the concept of the color property represented by his visual system when in his life he had phenomenally aquamarine experiences. Thus, we can conclude that how the colors phenomenally look does not change based on peoples’ concepts of them.

⁹⁷ A concept is only broad or narrow relative to another concept. A concept C1 is broader than another C2 =df a greater number of differing entities can satisfy C1 than C2. A concept C1 is narrower than another C2 =df a fewer number of differing entities can satisfy C1 than C2.

explanation is correct. In a pilot experiment very similar to the main experiment of this section, which was conducted in a room with natural daylight, the comparisons for red differed from the standard by 3 unit steps while the comparisons for green differed by 5 (as opposed to both differing by 5 in the present experiment), but this did not make a difference. The worksheets with green items revealed that the naming worksheet generated more variation than the matching worksheet; in contrast, the worksheets with red items generated similar variation.

With respect to my preferred explanation, the question remains whether the participants had a larger number of relatively narrow concepts or one or more broad concepts associated with the word ‘unique green.’ As Hardin (1988) reports, people’s unique color settings remain stable and reliable even for experimental sessions that are weeks apart (p. 39). In other words, there is a lot of intrapersonal consistency in the samples that people say fall under, for instance, the concept associated with ‘unique green,’ and so it would seem that the participants sharing one or more broad concepts cannot explain the results. Nevertheless, there is reason to be concerned about whether what Hardin reports can be used in this way. The reason is that plausibly the answer that a participant gives to the question, for example, “Which colored sample is unique green?” in the first session of an experiment designed to test his unique color settings has some influence on the color concept he associates with ‘unique green.’

In order to test whether participants have a larger number of relatively narrow concepts or one or more broad concepts associated with ‘unique green,’ I propose a one trial test thus avoiding the above worry. In my proposed test, participants would be presented with either green or red worksheets like the naming sheets in figure 1.

Participants who received the red worksheet would be asked to circle every box that exemplifies unique red and participants who received the green worksheet would be asked to circle every box that exemplifies unique green. It is important that participants be informed that a unique color is one that appears to have no neighboring hues in it, as plausibly they would not know what the word ‘unique’ means given the context. My pilot experiment (which was very similar to the main experiment of this paper) suggests that if participants are not specifically instructed to only circle one box, they will circle multiple boxes to exemplify a unique color.

Regardless of whether our participants had a larger number of relatively narrow concepts or one or more broad concepts associated with the word ‘unique green’, it is important to appreciate that participants recognize more different greens than different reds. On a 160 Munsell chip array about 30% of the chips are described as falling under the basic color term ‘green,’ while less than 10% are described as falling under the basic color term ‘red’ (Roberson et al., 2000). My rationale for thinking that this is important is twofold: (a) If people can distinguish between more greens than reds, then plausibly during our lives we encounter more objects that look not to be red than not to be green. So, during our lives we are likely presented with more plausible samples for unique green than unique red. (b) There is empirical evidence that both the variation in the association of concepts with words across individuals and the narrowness of a concept within individuals depend on the number of different examples used during instruction (Posner & Keele, 1968; Heit & Feeney, 2005).

With regard to the association of concepts with words, Fried & Holyoak (1984) found that participants trained using myriad visually disparate examples (e.g. more

dissimilar checkerboard patterns) exhibit more variable performance when asked to perform certain relevant tasks than people trained using less disparate examples (e.g. more similar checkerboard patterns).⁹⁸ Regarding the narrowness of concepts, French et al. (2004) conducted a study in which infants were familiarized with either pictures of cats or dogs. The cats represented by the cat pictures were highly variable in their features (e.g. ear and hair length), while the dogs represented by the dog pictures were less variable. After repeated exposure, the infants were presented with both a novel cat and a novel dog picture. Those infants who were familiarized with cat pictures showed no preference for looking at either novel picture, suggesting that they had formed a broad concept satisfied by both dogs and cats. In contrast, those infants who had been familiarized with dog pictures preferred looking at the novel cat picture, suggesting that they had formed a narrower concept that was not satisfied by cats.

In addition to people recognizing a lot more greens than reds, they also recognize a lot more blues than reds (Roberson et al., 2000). Thus, just as we found significantly more variation with the green naming than matching task, I expect more variation in blue naming tasks than matching ones. This consequence not only shows a plausible way of testing my preferred explanation but also further weakens the support that the empirical evidence for mass interpersonal variation provides for P-Disagreement.

⁹⁸ The results found with arbitrary stimuli, such as checkerboard patterns, extends to more natural stimuli such as speech sounds (Wade, Jongman & Sereno, 2007) and to detection of dangerous items in a briefcase via an X-ray image (Gonzalez & Madhavan, 2010).

Section 3: The evolution argument

I have shown that P-Disagreement is not supported by the empirical literature. Let us now examine the philosophical argument based on evolution for P-Disagreement. The evolutionary argument runs as follows:

Ev1. A person's color space has no impact on his evolutionary fitness.

Ev2. Mutations for color transformations could have easily occurred in our evolutionary past. (An easy way to understand the idea of a color transformation is to imagine your experience of the rainbow being inverted. If you were to suddenly have your experience of the rainbow inverted it would appear to you roughly as if the rainbow had suddenly turned upside-down.)

(3). Therefore, P-Disagreement is probably true (Chalmers, 2006; Byrne and Hilbert, 2007b).

3. 1: Transformations and fitness

There are two problems with the evolution argument. The first problem is that Ev1 is false, because most transformations of color space would have an influence on evolutionary fitness. The second problem is that there is no reason to think that the color transformations that would have no impact on fitness could have easily occurred in our evolutionary past. The rationale for why most transformations would affect fitness is twofold: First, there are asymmetries in color space (Palmer, 1999), and second, any transformation that did not respect these asymmetries would result in detectable behavioral anomalies and so would have an effect on fitness. The two asymmetries that I will discuss are color composition and lightness.

Let us look first at color composition. It is generally accepted today that there are both binary and unitary colors. Binary colors (which include all but four of the colors) are composed in some sense of the unitary colors (unique red, unique yellow, unique green, and unique blue), while the unitary colors in the same sense have no proper parts. Thus, any attempt to invert a person's color space that failed to respect the binary/unitary distinction would have behavioral consequences. For example, it is impossible to invert a person's color space by inverting the colors of the rainbow without the inversion being behaviorally detectable. Someone whose color space was inverted in this way, unlike those with normal vision, would perceive a unique purple, unique chartreuse, unique orange, and unique cyan (Palmer, 1999 p. 925).

Let us now examine lightness. When philosophers like Chalmers (2006) theorize about the possibility of color transformations, they often underestimate the dimensionality of color space. There are three dimensions to color space, hue, saturation, and lightness (sometimes also called "brightness" by philosophers although "lightness" is the correct term). A color's hue, saturation, and lightness correspond to its position in color space, see figure 4.3.

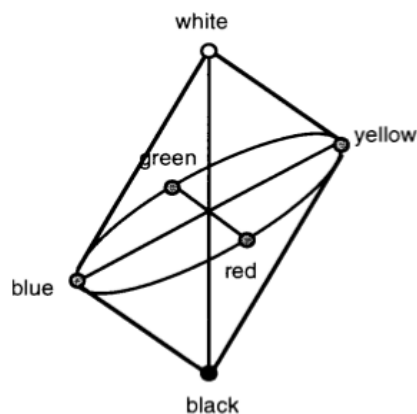


Figure 4.3. The dimensions of color space (Palmer, 1999)

A color's hue is the angular direction in the horizontal plane from its central axis to its location. This is the dimension that we sometimes associate with the color of an object. A color's saturation corresponds to the perpendicular distance from the central axis to its location. The higher a color's saturation the more pronounced (or vivid) the color appears. For example, the colors of the rainbow are located along the outside edge, for they are 100% saturated. A color's lightness corresponds to its height in figure 3. The higher a color's lightness the more washed out (or white) it appears. All colors have some lightness, but this dimension is most easily noticed with viewing the achromatic grays located along the central axis (Palmer, 1999).

A color circle like the one Newton developed represents the perimeter of an oblique slice of color space, see figure 4.4.

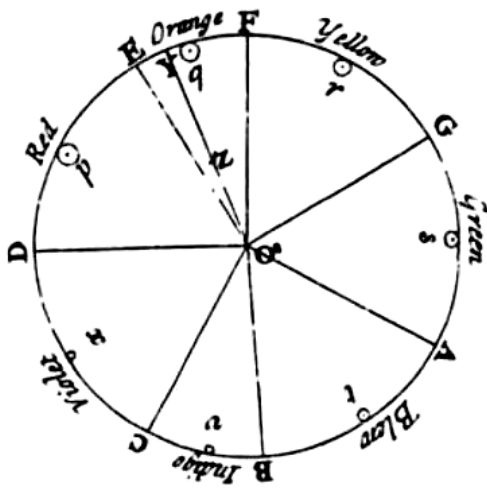


Figure 4.4. Newton's color circle

The reason is that the most saturated yellows are light and so higher in color space, whereas the most saturated blues are dark and so lower. Thus, any color transformation

must respect this difference in lightness amongst colors that are maximally saturated. For example, any attempt to rotate color space 180 degrees about its vertical axis would be behaviorally detectable. Such a rotation would result in making the most saturated yellows appear dark and the most saturated blues appear light. In fact, according to Palmer (1999, p. 295-296) color space has no rotational symmetries. Thus, any rotational color transformation would be detectable.

Most color transformations would be behaviorally detectable and so would have an effect on fitness. However, it appears like there are three (approximate) symmetries in color space (Palmer, 1999, p. 926). These symmetries allow for three different transformations all of which would be largely if not completely undetectable, see figure 4.5.

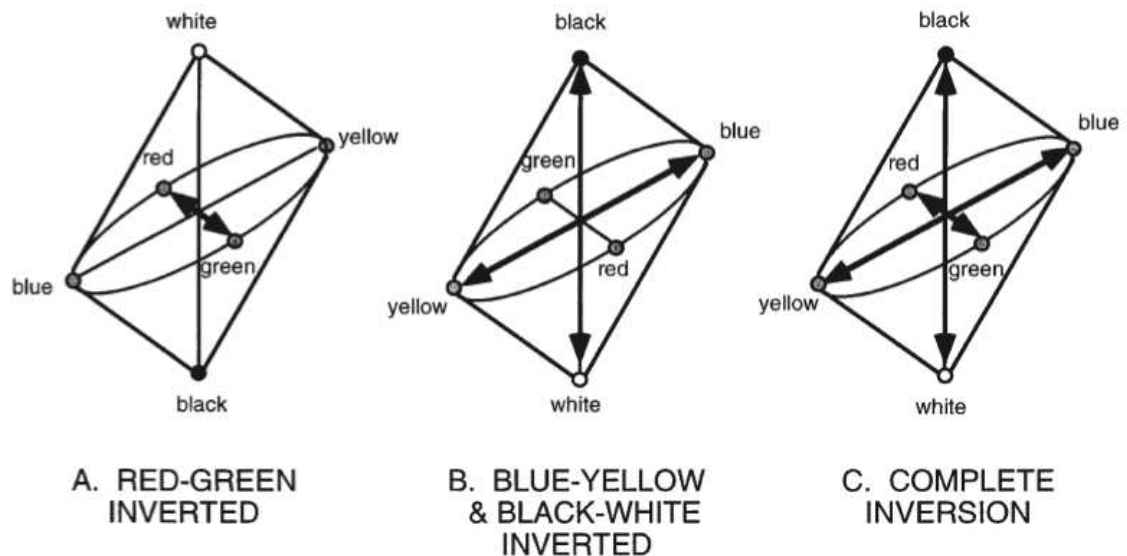


Figure 4.5. Behaviorally undetectable transformations (Palmer, 1999)

Color space can be inverted with respect to red and green in the blue-yellow-black-white plane without much if any effect on evolutionary fitness (figure 4.5.A) for

two reasons; First, red and green are approximately the same in lightness, and second blue and yellow are mapped to themselves thus respecting the binary/unitary distinction. Color space can be inverted with respect to the blue-yellow and black-white axis (figure 4.5.B) without much if any effect on fitness, because this inversion approximately reverses the lightness for the black-white dimension. Reversing the black-white dimension solves the lightness problem that would arise from just trying to invert the blue-yellow axis. Finally, color space can be completely inverted (figure 4.5.C) without having much if any effect on fitness, because a complete inversion respects the binary/unitary distinction and roughly the lightness asymmetry as well.

3. 2: Mutations and transformations

The second problem with the evolutionary argument is as follows: There are only three transformations that would have no effect on evolutionary fitness. Thus, for the evolution argument to be convincing, it must be the case that mutations causing red-green, blue-yellow and black-white, or complete inversion could have easily occurred. Call this “Ev2*.” Unfortunately, Ev2* unlike the original version lacks any support whatsoever. Ev2 is supported by the fact that there are many known variations to human color space. For example, 8% of males have color spaces that do not coincide with the majority. Contrary to this, Ev2* is not supported by there being known examples of the relevant transformations, because the transformations are just the ones that are largely if not completely undetectable. Moreover, it is hard to imagine how to discover whether it would have been easy for the transformations to occur, for time obscures our ability to

answer questions about the past. Thus, the realist can avoid the argument from evolution by rejecting Ev2* as unmotivated and unverifiable conjecture.

A likely reply to this line of argument is to insist that there is a reason to believe that red-green inverted people in specific actually exist (Nida-Rumelin, 1996). The argument runs as follows: The majority of humans are trichromats who have long-wavelength (L), short-wavelength (S), and medium-wavelength (M) cones each with their respective pigment. On the other hand, protanopes have a gene that causes their L cones to have the same pigment as their M cones, and deuteranopes have a gene that causes their M cones to have the same pigment as their L cones. Both protanopes and deuteranopes are red-green color blind, because the human visual system processes this dimension of color space by taking the difference between the outputs of the M and L cones. Thus, it seems that if someone had the protanope gene and the deuteranope gene, then they would be red-green inverted with respect to trichromats.

I do not think that this reply can succeed. The reply involves inheriting red-green inversion not with a mutation for red-green inversion. However, just because it is possible to inherit red-green inversion based on inheriting some combination of genes does not imply that mutations for red-green inversion could have easily occurred. Thus, the reply fails to adequately support Ev2*. Moreover, inheriting red-green inversion would require inheriting both the protanope gene and the deuteranope gene, but both of these genes are rare in the population. Hence, it would be extremely unlikely for anyone to inherit red-green inversion. Therefore, inheriting red-green inversion cannot account for P-Disagreement.

3. 3: The best explanation?

What if a species of the evolution argument were shown to succeed? Perhaps it is determined in the future that mutations causing red-green, blue-yellow and black-white, or complete inversion could have easily occurred in our evolutionary past. If a species of the argument were to succeed, P-Disagreement would probably be true. Thus, assuming Incompatibility and Objectivism, we would have to hold that Veridicality is probably false. This would be an unhappy consequence for any commonsense philosopher. Even so, I think that the realist who accepts Incompatibility and Objectivism like I do has some hope of resisting the irrealist argument. The reason is that, given the evolution argument for P-Disagreement, my proponent can say that the best explanation of Veridicality being false would seem to be that (1) red-green, blue-yellow and black-white, or complete inversion would have no impact on fitness, and (2) mutations for these color transformations could have easily occurred. However, realism and P-Disagreement are certainly not happy bedfellows and so it would be better to secure Veridicality.

Conclusion

As I said, the argument from mass disagreement is roughly that the best explanation of there being mass perceptual disagreement about the colors of objects is that irrealism is true. Why should one accept that there is mass perceptual disagreement about the colors of objects? One motivation is that the claim is supported by the empirical literature. The other motivation comes from a philosophical argument based on evolutionary speculation. I argued that the empirical literature does not support there being mass perceptual disagreement about the colors of objects and then also that the evolutionary

argument fails. In the end, I have shown that the argument from mass disagreement rests on an unverified premise and so can be rejected.

Summary Conclusion

This essay was divided into four parts. The first was entitled “Stage setting” and had two subparts. In 1.1, I provided a more thorough explanation of the question of which this essay is concerned, i.e. the question “what are the colors?” I first discussed how I think we should understand this question. I then looked at how we ought to identify (or pick out) the properties with which I am concerned. In 1.2, I concentrated on providing a taxonomy of views. I first examined the two newest taxonomies and explained why they are unsatisfactory. Specifically, I looked at Brogaard’s and then Cohen’s. I then provided an argument against the colors being dispositions. Having learned from the vices and virtues of Brogaard and Cohen’s taxonomies, I provided a much-improved way of taxonomizing views on color. My taxonomy ruled out certain views, clarified others, and showed that there is an unnoticed view worthy of serious consideration.

Part 2 was entitled “Dispositional views” and had three subparts. In 2.1, I argued against appearance dispositional views. I looked at the motivation for internal variants of appearance dispositionalism and then the motivation for external variants. After doing this, I discussed the argument from circularity against circular variants of appearance dispositionalism. Finally, I inspected non-circular variants. In 2.2, I argued against reflectance dispositionalism. First, I sharpened reflectance dispositionalism and explained its motivation. Second, I argued that reflectance dispositionalism succumbs to the modal version of the objection from structure. Third, I showed that reflectance dispositionalism succumbs to the objection from metamers. Finally in 2.3, I provided a general argument against the colors being dispositions. I first argued for a revised version of the simple conditional analysis (SCA). Having argued for the revised SCA, I then showed that the

colors are not analyzable by it. I did this by first presenting the general argument form and then defending the premise that the colors are not analyzable by the revised SCA.

Part 3 was entitled “Categorical views” and had three subparts. In 3.1, I argued against micro-structuralism. First, I explained the original motivation for micro-structuralism and its problems. Second, I presented an argument against micro-structuralism similar to the argument from metamers called ‘the problem of multiple causes.’ Third, I presented the problem of chromatic twin-earth. In 3.2, I argued against Cohen’s relationalism. My first aim was to give a precise formulation of Cohen’s view. My second aim was to argue that the color variation argument used to support Cohen’s view is unconvincing. My third aim was to argue that Cohen’s response to the objection that his view implies certain absurdities is incompatible with the argument for his view. My fourth aim was to defend the introspective rejoinder that Cohen’s relationalism stands in stark contrast to our phenomenally-informed, pre-theoretic intuitions. Finally in 3.3, I argued for and defended non-relational primitivism. First, I presented my positive argument for this view. Second, I defended non-relational primitivism from a battery of objections proposed mainly by Byrne and Hilbert but also by Hardin.

In the last major section of this essay, I looked at whether we should give up on the belief that external objects are colored. This section had only one subpart. In this part, I rejected the argument that the best explanation of mass disagreement is that irrealism is true. I first argued that the empirical literature does not support there being mass perceptual disagreement about the colors of objects. I then argued that the evolutionary argument provides no reason to think that there is mass disagreement. Ultimately, in this essay I have shown that appearance dispositionalism, reflectance dispositionalism, micro-

structuralism, and Cohen's relationalism all have serious problems and so should be rejected; that non-relational primitivism accounts for our core beliefs about the colors better than these other views and avoids the objections levied against it; and that there is no reason to give up on realism about the colors.

References

- Algina, J., Olejnik, S., & Ocanto, R. (1989). Type I error rates and power estimates for selected two-sample tests of scale. *Journal of Educational Statistics, 14*, 373-384.
- Allen K. (2007). The mind-independence of colour. *European Journal of Philosophy, 15*, 137-158.
- Allen, K. (2009a). Inter-species variation in colour perception. *Philosophical Studies, 142*, 197-220.
- Allen, K. (2009b). Being coloured and looking coloured. *Canadian Journal of Philosophy, 39*, 647-670.
- Allen, K. (2010a). In defense of natural daylight. *Pacific Philosophical Quarterly, 91*, 1-18.
- Allen, K. (2010b). Locating the unique hues. *Rivista di Estetica, 43*, 13-28.
- Allen, K. (2011). Revelation and the nature of colour. *Dialectica, 65*, 153-176.
- Armstrong, D. M. (1968). *A materialist theory of mind*. London: Routledge & Kegan Paul.
- Armstrong, D. M. (1973). *Belief, truth, and knowledge*. New York: Cambridge University Press.
- Armstrong, D.M. (1983). *What is a Law of Nature?* Cambridge: Cambridge University Press.
- Armstrong, D.M. (1987). Smart and the secondary qualities. In *Metaphysics and Morality: Essays in Honour of J. J. C. Smart*, eds., P. Pettit, R. Sylvan and J. Norman. Oxford: Basil Blackwell. Reprinted in Byrne and Hilbert 1997, 33–46.

- Armstrong, D. M. (1997). *A World of States of Affairs*. Cambridge: Cambridge University Press.
- Ayama, M., Nakatsue, T., Kaiser, P. (1987). Constant hue loci of unique and binary hues at 10, 100, and 1000 Td. *Journal of the Optical Society of America A*, 4, 1136–1144.
- Barbur, J. L, Rodriguez-Carmona, M., Harlow, J. A., Mancuso, K., Neitz, J., & Neitz, M. (2008). A study of unusual Rayleigh matches in deutan deficiency. *Visual Neuroscience*, 25, 507–516.
- Barker, S. (2013). The emperor's new metaphysics of powers. *Mind*. doi: [10.1093/mind/fzt082](https://doi.org/10.1093/mind/fzt082).
- Barker, S. & Smart, B. (2012). The ultimate argument against dispositionalist monist accounts of laws. *Analysis*, 72, 714-723.
- Bennett, J. (1971). *Locke, Berkeley, Hume: Central Themes*. Oxford: Clarendon Press.
- Berkeley, G. (1707-8). *Philosophical Commentaries*, in M. Ayers ed., *Philosophical Works*, London: Everyman, 1975.
- Berlin B., & Kay, P. (1969). *Basic Color Terms: Their Universality and Evolution*. Berkeley: University Press.
- Billock, V. A., Gleason, G. A., & Tsou, B. H. (2001). Perception of forbidden colors in retinally stabilized equiluminant images: An indication of softwired color opponency? *Journal of the Optical Society of America*, 18, 2398-2403.
- Bird, A. (1998). Dispositions and antidotes. *Philosophical Quarterly*, 48, 227-234.
- Bird, A. (2005a). The dispositionalist conception of laws. *Foundations of Science*, 10, 353-70.

- Bird, A. (2005b). Laws and essences. *Ratio*, 18, 437-461.
- Bird, A. (2007). *Nature's metaphysics: Laws and properties*. Oxford: Oxford University Press.
- Boghossian, P. A. & Velleman, J. D. (1989). Color as a secondary quality. *Mind*, 98, 81-103.
- Boghossian, P. A. & Velleman, J. D. (1991). Physicalist theories of color. *Philosophical Review*, 100, 67-106.
- Boyd, R. (1988). How to be a moral realist. In G. Sayre-McCord, ed., *Essays on Moral Realism*. Ithaca, NY: Cornell University Press.
- Braddon-Mitchell, D., and Jackson, F. (2007). *Philosophy of Mind and Cognition*. Oxford: Blackwell.
- Brentano, F. (1907). *Untersuchungen zur Sinnespsychologie*, reprinted Hamburg: Felix Meiner Verlag.
- Brewer, W. (1999). *Perception and Reason*. Oxford: Clarendon Press.
- Brill, M. H. (2003). "Color realism" shows a subjectivist mode of thinking. *Behavioral and Brain Sciences*, 26, 23-24
- Broackes, J. (1997). The autonomy of color. In A. Byrne & D. Hilbert eds., *Readings on color 1: The philosophy of color*. Cambridge, MA: MIT Press.
- Brogaard, B. (2010a). Color. *Oxford Bibliographies Online: Philosophy*
doi:10.1093/obo/9780195396577- 0021.
- Brogaard, B. (2010b). Perspectival truth and color primitivism. In C. Wright and N. Pederson, eds., *New Waves in Truth and Pluralism*. Basingstoke, UK: Palgrave Macmillan.

- Byrne, A. (2006). Comments on Cohen, Mizrahi, Maund, and Levine. *Dialectica*, 60, 223-244.
- Byrne, A. & Hilbert, D. R. (1997). Colors and reflectances. In A. Byrne & D. Hilbert, eds., *Readings On Color*. MIT Press.
- Byrne, A. & Hilbert, D. R. (2001). Do colours look like dispositions? Reply to Langsam and others. *The Philosophical Quarterly*, 51, 238-245.
- Byrne, A., & Hilbert, D. R. (2003a). Color realism and color science. *Behavioral and Brain Sciences*, 26, 3-21.
- Byrne, A., & Hilbert, D. R. (2003b). Color realism redux. *Behavioral and Brain Sciences*, 26, 791-794.
- Byrne, A., & Hilbert, D. (2004). Hardin, Tye and color physicalism. *Journal of Philosophy*, 101, 37-43.
- Byrne, A., & Hilbert, D. (2007a). Truest blue. *Analysis*, 67, 87-92.
- Byrne, A. & Hilbert, D. (2007b). Color primitivism. *Erkenntnis*, 66, 73-105.
- Byrne, A. & Hilbert, D. (2010). How do things look to the color-blind? In Jonathan D. Cohen and Mohan Matthen eds., *Color Ontology and Color Science*. MIT Press.
- Byrne, A. & Hilbert, D. (2011) Are Colors Secondary Qualities? In L. Nolan, ed., *Primary and Secondary Qualities*. Oxford University Press.
- Byrne, A. & Tye, M. (2006). Qualia ain't in the head. *Noûs*, 40, 241-255.
- Campbell, J. (1993). A simple view of colour. In J. Haldane & C. Wright, eds., *Reality, Representation and Projection*. Oxford: Oxford University Press.
- Campbell, J. (2002). *Reference and consciousness*. Oxford: Oxford University Press.
- Campbell, J. (2005). Transparency versus revelation in color perception. *Philosophical Topics*, 33, 105-115.

- Carroll, L. (1994). *Laws of Nature*. New York, NY: Cambridge University Press.
- Chalmers, D. J. (1996). *The Conscious Mind*. New York: Oxford University Press
- Chalmers, D. J. (2006). Perception and the fall of Eden. In T. Gendler & J. Hawthorne, eds., *Perceptual Experience*. Oxford: Oxford University Press.
- Changizi, M. A., Zhang, Q., & Shimojo, S. (2006). Bare skin, blood and the evolution of primate colour vision. *Biology Letters*, 2, 217-221.
- Choi, S. (2009). The conditional analysis of dispositions and the intrinsic dispositions thesis. *Philosophical and Phenomenological Research*, 78, 568-590.
- Churchland, P. (1986). *Neurophilosophy*. Cambridge, MA: MIT Press.
- Cohen, J. (2003a). On the structural properties of the colours. *Australasian Journal of Philosophy*, 81, 78-95.
- Cohen, J. (2003b). Color: A functionalist proposal. *Philosophical Studies*, 113, 1-42.
- Cohen, J. (2004). Color properties and color ascriptions: A relationalism manifesto. *Philosophical Review*, 113, 451-506.
- Cohen, J. (2006a). Colour and perceptual variation revisited: Unkown facts, alien modalities, and perfect psychosemantics. *Dialectica*, 60, 307-319.
- Cohen, J. (2006b). Color, variation, and the appeal to essences: Impasse and resolution. *Philosophical studies*, 133, 425-438
- Cohen, J. (2007). A relationist guide to error about color perception. *Nous*, 41, 335-353.
- Cohen, J. (2009). *The red and the real*. Oxford University Press.
- Cohen, J., Hardin, C. L. & McLaughlin, B. P. (2006). True colours. *Analysis*, 66, 335-340.
- Cohen, J. & Nichols, S. 2010. Colours, colour relationalism, and the deliverances of introspection. *Analysis*, 70, 218-228.

- Cohen, S. (1988). How to be a Fallibilist. *Philosophical Perspectives*, 2, 91–123.
- Cohen, S. (1999). Contextualism, Skepticism, and the Structure of Reasons. *Philosophical Perspectives*, 13, 57–89.
- Conover, W. J., Johnson, M. E., & Johnson, M. M. (1981). Comparative study of tests for homogeneity of variances: with applications to the outer continental shelf bidding data. *Technometrics*, 23, 351-361.
- Cook Wilson, J. (1926), Primary and Secondary Qualities. In A. Farquharson ed., *Statement and Inference*, Vol. II. Oxford: Oxford University Press.
- Cook, R., Kay, P., & Regier, T. (2011). The World Color Survey. Retrieved November 15, 2011, <http://www.icsi.berkeley.edu/wcs/>
- Crane, T. & Mellor, D.H. (1990). There is no Question of Physicalism. *Mind*, 99, 185–206.
- Crane, H. & Piantinida, T. P. (1983). On seeing reddish green and yellowish blue. *Science*, 221, 1078-1080
- Cross, Troy (2005). What is a disposition? *Synthese*, 144, 321-41.
- Dancy, J. & Hookway, C. (1986). Two conceptions of moral realism. *Proceedings of the Aristotelian Society*. Supplementary Volume 60, 167–87.
- DeRose, K. (1995). Solving the Skeptical Problem. *Philosophical Review*, 104, 1–52.
- Descartes, R. (2008). *Principles of Philosophy*. Retrieved from <http://www.earlymoderntexts.com/pdf/descprin.pdf>
- Dretske, F. (1970). Epistemic Operators. *Journal of Philosophy*, 67, 1007–1023.
- Dretske, F. (1981). The Pragmatic Dimension of Knowledge. *Philosophical Studies*, 40, 363–378.

- Dummett, M. (1979). Common Sense and Philosophy. In G. Macdonald ed., *Perception and Identity*. London: Macmillian, 1–40.
- Egan, F. (2008). The content of color experience. *Philosophy and phenomenological research*, 76, 407-414.
- Egan, A. (2010). Comments on Jonathan Cohen's The red and the real. *Analytic Philosophy*, 53, 306-312.
- Ellis, B. (2001). *Scientific Essentialism*. Cambridge: Cambridge University Press.
- Enç, B. (1983). In Defense of the Identity Theory. *Journal of Philosophy*, 80, 279-298.
- Evans, G. (1980). Things Without the Mind. Reprinted in *Collected Papers*. Oxford: Clarendon Press, 1985.
- Fain, H., and Kaelin, E.F. (1960). Student Philosophical Opinions: A Survey. *Inquiry*, 3, 137-152.
- Fara, Michael (2005). Dispositions and habituals. *Nous*, 39, 43–82.
- French, R. M., Mareschal, D., Mermillod, M. and Quinn, P. C. (2004). The Role of Bottom-Up Processing in Perceptual Categorization by 3- to 4-Month Old Infants: Simulations and Data. *Journal of Experimental Psychology: General*, 133, 382-397.
- Fried, L. S., & Holyoak, K. J. (1984). Induction of category distributions: A framework for classification learning. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 10, 234-257.
- Galileo, G. (1960). The Assayer. (A. C. Danto, trans). In A. C. Danto and S. Morgenbesser, eds., *Philosophy of Science*. Cleveland and New York: Meridian books.

Gert, J. (2013). Color constancy and dispositionalism. *Philosophical Studies*, 162, 183-200.

Gibbard, A. (2006). Moral feelings and moral concepts. In R. Schafer-Landau ed., *Oxford Studies in Metaethics 1*. Oxford: Clarendon Press, 195–215.

Gibson, J. J. (1979). *The ecological approach to visual perception*. Boston: Houghton Mifflin.

Goethe, J. (1810). *Theory of Colours*, translated by C.L. Eastlake, Cambridge, Mass: MIT Press, 1970. (Original English publication, 1840.)

Goldman, A. (1979). What is Justified Belief. In G. Pappas ed., *Justification and Knowledge*. Dordrecht: Reidel, 1–23.

Gonzalez, C., & Madhavan, P. (2010). Diversity During Training Enhances Detection of Novel Stimuli. *Department of Social and Decision Sciences. Paper 116*. Retrieved from <http://repository.cmu.edu/sds/116>

Griebel, U., & Peichl, L. (2003). Colour vision in aquatic mammals—facts and open questions. *Aquatic mammals*, 29, 18-30.

Gocke, B. P. (2009). What is physicalism? *Ratio*, 22, 291-307.

Hacker, P. M. S. (1991). *Appearance and Reality*. Oxford: Basil Blackwell.

Hardin, C. L. (1988). *Color for Philosophers*. Indianapolis: Hackett.

Hardin, C. L. (2003). A spectral reflectance doth not a color make. *Journal of Philosophy*, 100, 192-202.

Hardin, C. L. (2004). A green thought in a green shade. *Harvard Review of Philosophy*, 12, 29-38.

- Harman, G. (1990). The Intrinsic Quality of Experience. *Philosophical Perspectives*, 4, 31–52.
- Heit, E., & Feeney, A. (2005). Relations between premise similarity and inductive strength. *Psychonomic Bulletin & Review*, 12, 340–344.
- Heller, M. (1999). Relevant Alternatives and Closure. *Australasian Journal of Philosophy*, 77, 196–208.
- Hempel, C. (1969) Reduction: Ontological and linguistic facets. In S. Morgenbesser, *et al.* eds., *Essays in Honor of Ernest Nagel*. New York: St Martin's Press.
- Hering, E. (1920). *Outlines of a Theory of the Light Sense*, trans. L. Hurvich and D. Jameson, Cambridge, Mass.: Harvard University Press, 1964.
- Hilbert, D. R. (1987). *Color and color perception: A study in anthropocentric realism*. CSLI, Stanford.
- Humberstone, I. L. (1996). Intrinsic/Extrinsic. *Synthese*, 108, 205-267.
- Jackson, F., (1993). Armchair Metaphysics. In J. Hawthorne and M. Michael eds., *Philosophy in Mind*, Amsterdam: Kluwer.
- Jackson, F. (1996). The primary quality view of color. *Philosophical Perspectives*, 10, 199-219.
- Jackson, F. (2012). Leibniz's Law and The Philosophy of Mind. *Proceedings of the Aristotelian Society*, 112.
- Jacobs, G. H. (1981). *Comparative color vision*. New York: Academic Press.
- Jacobs, G. H. & Deegan II, J. F. (1999). Uniformity of colour vision in old world monkeys. *Proceedings of the Royal Society. Biological Sciences*, 266, 2023-2028.
- Japanese Ophthalmological Society. (2003). *Establishment of the society at the return of the*

century. Retrieved December 30, 2010, from

<http://www.nichigan.or.jp/english/ophthalmology.jsp>

- Johnston, M. (1992). How to speak of the colours. *Philosophical Studies*, 68, 221-263.
- Johnston, M. (1997). Postscript: visual experience. In A. Byrne and D. R. Hilbert. eds., *Readings on Color, Volume 1: The Philosophy of Color*. Cambridge, MA: MIT Press.
- Johnston, M. (1998). Are manifest qualities response-dependent? *The Monist*, 81, 3-43.
- Jordan, G. & Mollon, J.D. (1995). Rayleigh matches and unique green. *Vision Research*, 35, 613-620.
- Kalderon, M. E. (2007). Color pluralism. *The Philosophical Review*, 116, 563-601.
- Kay, P., & Weber, M. A. (2005). Variations in Color Naming Within and Across Populations, *Behavioral and Brain Science*, 28, 512-513.
- Khamara, E. J. (1988). Indiscernibles and the absolute theory of space and time. *Studia Leibnitiana*, 20, 140-159.
- Kim, J. (1993a). Multiple realization and the metaphysics of reduction. *Philosophy and Phenomenological Research*, 52, 1-26
- Kim, J. (1993b). The non-reductivist's troubles with mental causation. In John Heil & Alfred R. Mele, eds., *Mental Causation*. Oxford University Press.
- Klein, P. (1981). *Certainty: A Refutation of Skepticism*. Minneapolis: University of Minnesota Press.
- Kneale, W. (1950). Sensation and the Physical World. *Philosophical Quarterly*, 109-126.
- Krauskopf, J. (1963). Effects of retinal stabilization on the appearance of heterochromatic targets. *Journal of Optical Society of America*, 53, 741-744.

- Kripke, S. (1972). *Naming and necessity*. Cambridge: Harvard University Press.
- Kuehni, R. G. (2004). Variability in unique hue selection: a surprising phenomenon. *Colour Research and Application*, 24, 158-162.
- Land, E. H. (1977). The retinex theory of color vision. *Scientific American*, 231, 108-128.
- Levin, J. (2000). Dispositional Theories of Color and The Claims of Common Sense. *Philosophical Studies*, 100, 151–174
- Lewis, D. (1969). Review of *Art, Mind, and Religion*. *Journal of Philosophy*, 66, 23-35
- Lewis, D. (1986). *On the plurality of worlds*. Oxford: Blackwell.
- Lewis, D. (1994). Reduction of mind. In S. Guttenplan ed., *A Companion to the Philosophy of Mind*. Oxford: Blackwell, 412–431.
- Lewis, D. (1996). Elusive Knowledge. *Australasian Journal of Philosophy*, 74, 549–567.
- Lewis, D. (1997a). Naming the Colours. *Australasian Journal of Philosophy*, 75, 325-342.
- Lewis, D. (1997b). Finkish dispositions. *Philosophical Quaterly*, 47, 142-58
- Locke, J. (2004). *An essay concerning human understanding*. Retrieved from <http://www.earlymoderntexts.com/pdf/lockess2.pdf>
- Lutze, M., Cox, J., Smith, V., C., & Pokorny, J. (1990). Genetic Studies of Variation in Rayleigh and Photometric Matches in Normal Trichromats. *Vision Research*, 30, 149- 162.
- Macpherson (2012). Cognitive penetration of colour experience: Rethinking the issue in light of an indirect mechanism. *Philosophy and Phenomenological Research*, 84, 24-62.

- Malkoc, G., P. Kay & M. Webster. (2005). Variations in normal color vision. IV. Binary hues and hue scaling. *Journal of the Optical Society of America*, A 22, 2154–68.
- Martin, C. B. (1994). Dispositions and conditionals. *Philosophical Quarterly*, 44, 1-8
- Martin, C. B. (2008) *The mind in nature*. Oxford University Press.
- Maund, B. (1995). *Colours: Their nature and representation*. Cambridge University Press, New York.
- Mausfeld, R. & Niederée, R. (2003). Can a physicalist notion of color provide any insight into the nature of color perception? *Behavioral and Brain Sciences*. 26, 41-42.
- Matthen, M. (2005). *Seeing, doing, and knowing: A philosophical theory of sense perception*. Oxford: Oxford University Press.
- McCann, J. J., McKee, S. P., & Taylor, T. H. (1976). Quantitative studies in retinex theory. *Vision Research*, 16, 445-458.
- McDowell, J. (1985). Values and secondary qualities. In Ted Honderich, ed., *Morality and Objectivity*. New York: Routledge.
- McGinn, C. (1983). *The Subjective View: Secondary Qualities and Indexical Thoughts*. Oxford: Oxford University Press.
- McGinn, C. (1996). Another look at colour. *The Journal of Philosophy*, 93, 537–53.
- McKittrick, J. (2003). A case for extrinsic dispositions. *Australasian Journal of Philosophy*, 81, 155-174.
- Mclaughlin, B. P. (2003). The place of color in nature. In R Mausfeld & D. Heyer, eds., *Colour Perception: Mind and nature*. Oxford: Oxford University Press.
- Mellor, H. (1974). In defense of dispositions. *Philosophical Review*, 83, 157-81.
- Mellor, D. H. (1982). Counting corners correctly. *Analysis*, 42, 96-97.

- Miyahara, E. (2003). Focal colors and unique hues. *Perceptual Motor Skills*, 97, 1038–1042.
- Mizrahi, V. (2007). Color objectivism and pluralism. *Dialectica*, 60, 283-306.
- Molnar, G. (1999). Are dispositions reducible? *Philosophical Quarterly*, 50, 1-17
- Molnar, G. (2003). *Powers*. Oxford: Oxford University Press.
- Mumford, S. (1998). *Dispositions*. Oxford University Press.
- Mumford, S. (2004). *Laws in Nature*. New York: Routledge.
- Nassu, K. (1983). *The physics and chemistry of color. The fifteen causes of color*. New York: Wiley.
- Nassau, K. (1997). The causes of color. In Alex Byrne and David Hilbert, eds., *The Philosophy of Color, Volume 1: Readings on Color*. Cambridge, MA: MIT Press.
- Noë, A. (2004). *Action in perception*. Cambridge, MA: MIT Press.
- Nozick, R. (1981). *Philosophical Explanations*. Massachusetts: Harvard University Press.
- Nida-Rümelin, M. (1996) Pseudonormal vision: An actual case of qualia inversion? *Philosophical Studies*, 82, 145–57.
- Palacios, A., Martinoya, C., Bloch, S., & Varela, F. J., (1990). Color mixing in the pigeon. A psychophysical determination in the longwave spectral range. *Vision Research*, 30, 587-596.
- Palmer, S. (1999). Color, consciousness, and the isomorphism constraint. *Behavioral and Brain Sciences*, 22, 923-943
- Pautz, A. (2006). Can the physicalist explain colour structure in terms of colour experience? *Australasian Journal of Philosophy*, 84, 535-564.
- Peacocke, C. (1984). Colour concepts and color experience. *Synthese*, 58, 365-85.

- Posner M. I., & Keele, S. W. (1968). On the genesis of abstract ideas. *Journal of Experimental Psychology*, 77, 353–363.
- Prichard, H. A. (1909). *Kant's Theory of Knowledge*. Oxford: Clarendon Press.
- Prindle, S. S., Carello, C., & Turvey, M. T. (1980). Animal-environment mutuality and direct perception. *Behavioral and Brain Sciences*, 3, 395-397.
- Prior, E. (1981). Smith on dispositions. *Australasian Journal of Philosophy*, 59, 206-210.
- Prior, E. (1982). The dispositional/categorical distinction. *Analysis*, 42, 93-96.
- Prior, E. (1985). *Dispositions*. Aberdeen University Press.
- Prior, E., Pargatter, R., and Jackson, F. (1982). Three theses about dispositions. *American Philosophical Quarterly*, 19, 251-281.
- Putnam, H. (1956). Red, greens, and logical analysis. *The Philosophical Review*, 65, 206-217.
- Putnam, H. (1975). The meaning of “meaning.” In K. Gunderson, ed., *Minnesota Studies in the Philosophy of Science*. 7. Minneapolis, MN: University of Minnesota Press.
- Raftopoulos, A. (2005). Cognitive Penetrability of perception: Attention, strategies, and bottom-up constraints. New York: Nova Science.
- Reid, T. (2005). *Inquiry into the human mind*. Retrieved from <http://www.earlymoderntexts.com/pdf/reidinqu.pdf>
- Roberson, D., Davies, I., & Davidoff, J. (2000). Color categories are not universal: Replications & new evidence from a Stone-age culture. *Journal of Experimental Psychology: General*, 129, 369-398.
- Roberts P. (2013). Parsing the rainbow. *Synthese*, doi: 10.1007/s11229-013-0368-z
- Roberts, P., Andow, J., & Schmidtke, K. (2014) Colour relationalism and the real

- deliverances of introspection. *Erkenntnis*, doi: 10.1007/s10670-014-9600-6
- Roberts, P. & Schmidtke, K. (2012). In defense of incompatibility, objectivism, and veridicality about color. *Review of Philosophy and Psychology*, 3, 547-558
- Runeson, S. (1988). The distorted room illusion, equivalent configurations, and the specificity of static optic arrays. *Journal of Experimental Psychology: Human Perception and Performance*, 14, 295-304.
- Russell, B. (1912). *The problems of philosophy*. London: OUP.
- Ryle, G. (1949). *The Concept of Mind*. Harmondsworth: Penguin Books.
- Scheffrin, B. E., & Werner, J. S. (1990). Loci of spectral unique hues throughout the life span. *Journal of the Optical Society of America A*, 7, 305-311.
- Schiffer, S. (1987). *Remnants of Meaning*. Cambridge, MA: MIT Press.
- Schiffman, H. R. (2001). *Sensation and perception, an integrated approach*. New York, NY: John Wiley & Sons, INC.
- Shoemaker, S. (1975). Functionalism and Qualia. *Philosophical studies*, 27, 291-315.
- Shoemaker, S. (1982). The inverted spectrum. *Journal of Philosophy*, 79, 357-381.
- Shoemaker, S. (1984). Causality and properties. In *Identity, Cause, and Mind*, New York: Cambridge University Press, 206-233.
- Shoemaker, S. (1990). Qualities and Qualia: What's in the mind? *Philosophy and Phenomenological Research*, 50, 109-131.
- Shoemaker, S. (1991). Qualia and consciousness. *Mind*, 100, 507-524.
- Shoemaker, S. (1994). Self-knowledge and 'inner sense' (Lecture III: the phenomenal character of experience). *Philosophy and Phenomenological Research*, 54, 219-314.

- Shoemaker, S. (1998). Causal and Metaphysical Necessity. *Pacific Philosophical Quarterly*, 79, 59–77.
- Smart, J. J. C. (1963). *Philosophical and scientific realism*. London: Routledge & Kegan Paul.
- Smart, J. J. C. (1975). On some criticisms of a physicalist theory of colour. In Chung-yin-Chen ed., *Philosophical Aspects of the Mind-Body Problem*. Honolulu: University Press of Hawaii, 54-63.
- Smart, J.J.C. (1978) The content of physicalism. *Philosophical Quarterly*, 28, 239–41.
- Smith, A. D. (1977). Dispositional properties. *Mind*, 86, 439-445.
- Speaks, J. (2009). Transparency, intentionalism, and the nature of perceptual content. *Philosophy and Phenomenological Research*, 79, 539-573.
- Starr, C. (2005). *Biology: Concepts and Applications*. Thomson Brooks/Cole.
- Strawson, G. (1989). ‘Red’ and red. *Synthese*, 78, 224.
- The American Society for Nondestructive Testing. (2003). *Back to basics: Fluorescent penetrant testing and color vision deficiencies*. Retrieved December 30, 2010, from <http://www.asnt.org/publications/materialseval/basics/jun03basics/jun03basics.htm>
- Thompson, E. (1992). Novel colors. *Philosophical Studies*, 68, 321-249.
- Thompson, E. (1995). *Colour Vision: A study in cognitive science and philosophy of perception*. New York: Routledge.
- Triplett, T. (2007). Tye’s missing shade of blue. *Analysis*, 67, 166-170.
- Turvey, M. T., Shaw, R. E., Reed, E. S., & Mace, W. M. (1981). Ecological laws of perceiving and acting: In reply to Fodor and Pylyshyn. *Cognition*, 9, 237-304.
- Tye, M. (2000). *Consciousness, color, and content*. Cambridge, MA: MIT Press.

- Tye, M. (2006). The puzzle of true blue. *Analysis*, 66, 173-178.
- Tye, M. (2012). Cohen on color relationalism. *Analytic Philosophy*, 53, 297-305.
- Vogel, J. (1990). Cartesian Skepticism and Inference to the Best Explanation. *Journal of Philosophy*, 87, 658–666.
- Wade, T., Jongman, A., & Sereno, J. (2007). Effects of acoustic variability in the perceptual learning of non-native-accented speech sounds. *Phonetica*, 64, 122-144.
- Watkins, M. (1999). Do Animals See Colors? An Anthropocentrist's Guide to Animals, the Color Blind, and Far Away Places. *Philosophical Studies*, 94, 189-209.
- Watkins, M. (2002). *Rediscovering colors: A study in pollyana realism*. Kluwer.
- Watkins, M. (2005) A posteriori primitivism. *Philosophical Studies*, 150, 123-137.
- Webster, M. A., & Kay, P. (2005). Variations in Color Naming Within and Across Populations. *Behavioral and Brain Sciences*, 28, 512-513.
- Westphal, J. (1987). *Colour: A philosophical introduction*. Basil Blackwell.
- Westphal, J. (2005). Conflicting Appearances, Necessity and the Irreducibility of Propositions about Colours. *Proceedings of the Aristotelian Society*, 105, 219-235.
- Wiggins, D. (1987). A sensible subjectivism. In *Needs, Values, Truth*. Oxford: Basil Blackwell.
- Wright, A. A., & Cumming, W. W. (1971). Color Naming functions for the pigeon. *Journal of the Experimental Analysis of Behavior*, 15, 7-17.
- Wright, W. D., & Pitt, F. H. G. (1934). Hue discrimination on normal colour-vision. *Proceedings of the Physical Society (London)*, 46, 459–454.
- Wuerger, S. M., Atkinson, P. & Cropper, S. (2005). The cone inputs to the unique-hue

mechanisms. *Vision Research*, 45, 3210– 3223.

Yablo, S. (1992). Mental causation. *Philosophical Review*, 101, 245-280.

Yablo, S. (1995). Singling out properties. *Philosophical Perspectives*, 9, 477–502.

Zajonc, R. B. (1968). Attitudinal Effects of Mere Exposure. *Journal of Personality and Social Psychology*, Monograph Supplement 9, 1-27.