Forthcoming in *How Colours Matter to Philosophy*, ed. Marcos Silva. Cham, Switzerland: Springer International Publishing AG. Revised June 2017.

What the Mind-Independence of Color Requires

Peter W. Ross pwross@cpp.edu

 The early modern distinction between primary and secondary qualities continues to significantly influence the debate about the nature of color. Philosophers in the current and recent literature on color often cast their views as secondary quality accounts tracing a lineage back to Galileo or Locke. These castings are commonly used merely to call up a familiar model, allowing a view to be quickly categorized. But examination of early modern models can also suggest reconceiving current problems in productive ways. An ambitious example of this approach is Evan Thompson’s (1995) use of historical analysis of perception, and of primary and secondary qualities as perceived qualities, to identify and side step the traps of misguided early modern thinking.[[1]](#endnote-1) I aim to support a current contender in the debate, namely color physicalism, by joining Thompson in this critical historical approach.

 I take color physicalism to claim that any instance of a color is a physical quality of objects. According to the version of physicalism I support, however, color as a type of quality is not a natural kind of physics.[[2]](#endnote-2)

I’ll characterize color as a physical quality of a different sort, which, in conjunction with modeling color perception as a kind of information filter, I’ll call a filter-accessed quality. I’ll argue that as a physical quality of this type, color is mind-independent. However, ideas about what the mind-independence of color requires that have been influential since the early modern period have set up significant obstacles to accepting the mind-independence of this sort of physical quality.

One such influential idea is that the mind-independence of color requires that it is a primary quality. Thus, using shape as a paradigm example of a primary quality, a common strategy for considering whether color is mind-independent is to consider whether it is sufficiently similar to shape to be a primary quality. But the concept of a primary quality is a theoretical concept, and from the time of the early modern introduction of the primary-secondary quality distinction, the philosophical and scientific theories that have given this concept content have changed, making the concept of primary quality a moving target. Although mind-independence has consistently been a core characteristic of primary qualities, primary qualities haven’t been characterized simply as mind-independent qualities, but have been given additional characteristics that make the mind-independence of primary qualities plausible.

 I’ll describe two different models of primary qualities, a historical model from the early modern period, and a current model. These models differ in the additional characteristic that makes the mind-independence of primary qualities plausible (in the early modern model this characteristic is explanatory fundamentality, and in the current model it is involvement in causal interactions among objects). Since color does not fit the additional characteristic for either model, color is not a primary quality on either model.

I’ll argue, however, that looking to primary quality models to understand what’s required for the mind-independence of color has been a mistake. The idea that the mind-independence of color requires that it is a primary quality is in fact a trap of mistaken early modern thinking. I’ll argue to the contrary that while color is not a primary quality, it is mind-independent.

 In Section I, I’ll broadly describe the early modern and current models of primary qualities. While these models offer different characterizations of primary qualities, both models have been used to establish what the mind-independence of color requires.

 In Section II, I’ll show that prominent current arguments against color physicalism, and in particular the argument from structure against physicalism, assume that if color is mind-independent it is a primary quality. Then in Section III, I’ll propose an alternative understanding of what the mind-independence of color requires. This alternative, founded on a proposed information filter model of color perception, allows that color is mind-independent even though it is not a primary quality. According to the information filter model, mental qualities that I’ll call media qualities are involved in color perception. The involvement of mental qualities suggests mind-dependence. However, I’ll argue, their involvement should be modeled after the qualities of a kind of filter that provides access to, but does not constitute, filter-accessed qualities. In Section IV, I’ll end by showing that Thompson himself falls into the trap of accepting the early modern idea that the mind-independence of color requires that it be a primary quality, and as a result underestimates the plausibility of color physicalism.

1. Models of Primary Qualities
2. The early modern model of primary qualities

 I’ll use the term ‘mechanical philosophy’ for the early modern philosophical/scientific view according to which a small number of qualities of matter explain all other qualities of matter.[[3]](#endnote-3) These qualities, so-called primary qualities, include size, shape, and motion. Despite wide-ranging disagreement with respect to metaphysical and epistemological issues, there was broad agreement among mechanical philosophers, such as Galileo, Descartes, Hobbes, Boyle, and Locke, that size, shape, and motion are explanatorily fundamental with respect to all other material qualities (Smith, 1990, pp. 224-227; Wilson, 1992, p. 227; Galilei, 1989, pp. 56-61; Descartes, *Sixth Set of Replies*, 1984, p. 297; Hobbes, 1839, Part 2, Ch. 8, pp. 104-105; Jesseph, 2004, p. 201; Anstey, 2000, pp. 39-40, p. 50; Locke, 1975, Book II, Ch. 8, Sections 9 and 22; Downing, 1998, pp. 388-389). Furthermore, the explanatory fundamentality of primary qualities made their mind-independence plausible (Smith, 1990, pp. 229-234; Anstey, 2000, p. 27; Anstey says that their explanatory fundamentality made the mind-independence of primary qualities “unquestioned,” but, as Wilson [1992, p. 229] notes, Berkeley disagreed and attempted to “accommodat[e] the explanatory power of modern mechanistic science on his ‘immaterialist’ terms”). I’ll call the characterization of primary qualities as being explanatorily fundamental with respect to all other material qualities the *early modern model of primary qualities*.[[4]](#endnote-4)

 Mechanical philosophers used this model of primary qualities to establish what the mind-independence of color requires. Their basic claim regarding this issue was that if color is mind-independent, it is a primary quality, where this requires that it be explanatorily fundamental.

 Mechanical philosophers assumed that being a primary quality is sufficient for being mind-independent, given that the explanatory fundamentality of primary qualities made their mind-independence plausible. As well, they held that being a primary quality is a requirement for the mind-independence of color for at least two reasons. First, ideas of color and as well as sound, taste, smell, and warmth, along with ideas of size, shape, and motion, have a distinctive status. (In what follows, points with respect to ideas of color apply to ideas of sound, taste, smell, and warmth, but I’ll focus on ideas of color.) Locke claimed that ideas of primary qualities and of color are simple ideas of perception, and he described simple ideas as “the materials of all our knowledge” (1975, Book II, Ch. 2, Section 2). This indicates that the ideas of primary qualities and color are on a par with each other, and distinct from complex ideas, in being conceptually basic. Thus, requirements for the mind-independence of complex material qualities do not apply to color. The idea of the sun’s power to melt wax, for example, is a complex idea, and the requirement for mind-independence applicable to the power to which this complex idea refers is that it be explanatorily reducible in terms of primary qualities (Locke, Book II, Ch. 8, Sections 23-24).[[5]](#endnote-5) The idea of color, being simple, refers to a quality that isn’t explanatorily reducible at all, thus the requirement for the mind-independence of color is that it *be* a primary quality.

 Furthermore, Locke claimed that the idea of color is a simple idea that *seems* to attribute mind-independent qualities to material objects (1975, Book II, Ch. 8, Sections 24-25). Thus, the idea of color is like ideas of primary qualities both in being simple and in seeming to attribute mind-independent qualities. According to A. D. Smith (1990, pp. 232-233), due to these similarities in ideas of color and primary qualities, Locke thought of color as being a candidate primary quality. And Smith notes that this connection between color and primary qualities is not specific to Locke; rationalists agreed that the idea of color seems on a par with ideas of primary qualities in that it both is simple and it seems to attribute mind-independent qualities--at least “to untutored consciousness” (Smith, 1990, p. 232; see Descartes, who makes this point in the *Sixth Meditation*, 1984, pp. 56-58; also, Wilson, 1992, pp. 227-228 and p. 234, offers this point about mechanical philosophers generally).

Consequently, according to mechanical philosophers, if color is mind-independent, it is a primary quality. And on the early modern model, primary qualities are explanatorily fundamental. But color, not being explanatorily fundamental in a systematic science of matter, is not a primary quality.[[6]](#endnote-6)

1. The current model of primary qualities

 However, as physics and chemistry developed, not only have scientists overthrown size, shape, and motion as explanatorily fundamental with respect to all other material qualities, they have found that science has more than the mechanical philosophers’ material qualities to explain. So, for example, because the mechanical philosophers thought that forces are always conveyed by contact, fields were not part of mechanical philosophy. Furthermore, the identification of any fundamental explanatory qualities that might exist has become an empirical task for scientists. Even so, the primary-secondary quality distinction does remain relevant.

 As this combination of the continued relevance of the primary-secondary quality distinction and the preeminence of science with respect to fundamental explanatory qualities indicates, the philosophical motivation for considering the distinction has shifted. And in particular, philosophical interests have produced a shift away from a model of primary qualities according to which they are explanatorily fundamental in a systematic science of matter. A new model has developed that encompasses any qualities involved in causal interactions among objects as described by science or common sense. But this new model builds on the early modern model in a straightforward way. It simply holds that primary qualities include not only explanatorily fundamental qualities but also the non-fundamental qualities—for example, those represented by complex ideas such as the sun’s power to melt wax—that can be explained in terms of fundamental qualities. This expansion allows for change in the qualities that are explanatorily fundamental in science without a resulting change in primary quality status. Thus, while size, shape, and motion are no longer considered explanatorily fundamental in science, they remain primary qualities.

 For example, Jonathan Bennett’s influential criticism of Locke’s arguments for the primary-secondary quality distinction helped to establish this broadening. Bennett defended the distinction—about which “…there is something true and important which Locke…was struggling to say” (1965, p. 1). However, when Bennett stated what he took to be the correct account of the distinction between primary and secondary qualities, he ignored the early modern characterization of primary qualities as being explanatorily fundamental in a systematic science of matter. Instead, his defense merely rested upon size, shape, and motion causally interacting in indefinitely many commonsense ways, as, for instance, “a cube cannot roll smoothly on a flat surface” (1965, pp. 11-14; also see Bennett, 1971, pp. 96-100 and p. 105, and Wilson, 1992, pp. 215-219, who emphasizes that Bennett’s characterization of primary qualities in commonsense terms departs from Locke’s). Bennett’s point was to use these indefinitely many commonsense causal interactions among ordinary objects to characterize primary qualities as mind-independent qualities of ordinary objects, distinguishing them from secondary qualities defined as dispositional causal powers of the primary qualities of objects to bring about perceptual responses. Color, for example, is defined as a causal disposition to bring about visual responses, and it (this causal disposition as opposed to the primary qualities that ground it) cannot itself be described in terms of causal interactions among ordinary objects but only in terms of visual responses, and so is mind-dependent (1965, pp. 13-14; also see Bennett, 1971, pp. 99-106).[[7]](#endnote-7)

 Following Bennett’s lead, many theorists of the 1970s and 1980s claimed that the primary-secondary quality distinction differentiates mind-independent qualities of objects from qualities that, though attributed to objects, are defined in terms of perceptual responses, and where perceptual responses are in turn described by what it’s like to be conscious of colors, sounds, tastes, smells, and warmth. To take a representative example, Colin McGinn (1983 pp. 6-9) contended that though looking square does not define squareness, looking red defines redness (for other examples, see Peacocke, 1984, pp. 59-63; and Evans, 1980, pp. 94-99). Furthermore, McGinn, citing Bennett (1971), described secondary qualities as explanatorily idle, and in particular as “not contribut[ing] to the causal powers of things” (1983, p. 14), whereas primary qualities explain the causal interactions among objects and between objects and perceivers (1983, pp. 14-15). Though McGinn characterized primary qualities in terms of explanatory power (1983, p. 15), he, like Bennett, ignored the early modern characterization of primary qualities as being explanatorily fundamental in science. And like Bennett’s, his characterization of primary qualities focused on their involvement in commonsense causal interactions among ordinary objects.

 During the same period, other philosophers who were more engaged with science also broadened the concept of primary quality, but with the focus of including non-fundamental scientific qualities. By setting aside explanatory fundamentality, the concept of primary quality comes to include any explanatory quality of natural science. Keith Campbell, a philosopher notable for his use of color science to argue for claims about the nature of color (for example, in his 1969), proposed exactly this broadening.

 Campbell found “[t]he philosophy of primary and secondary qualities is in a state of some confusion” due to “an ambiguity in the purposes for which the distinction is made” (1972, p. 219). In response, Campbell clarified his aim in drawing the distinction as being an examination of the mind-independence of primary qualities by contrast with the mind-dependence of secondary qualities (1972, pp. 220-221).

 With this aim, Campbell expanded the concept of primary quality to include any quality involved in “patterns of interaction” among objects (1972, p. 225). He intended this description to encompass “being acidic, malleable, rust-proof…” (1972, p. 219), and, “…every quality for which we can devise a meter or detecting instrument, since distinctive interaction between the bearer of the quality and the detecting device…is both necessary and sufficient for its successful operation” (1972, p. 226). Thus, Campbell proposed that primary qualities are the qualities referred to by laws of science generally, ignoring the early modern characterization of primary qualities as being explanatorily fundamental in science. Considering Campbell’s involvement in an influential debate with David Armstrong and J.J.C. Smart about the nature of secondary qualities, his characterization of the primary-secondary quality provides a prominent understanding of the distinction at that time.[[8]](#endnote-8)

 Indeed, while the primary-secondary quality distinction often serves as a framework in the literature on the nature of color of the past 50 years, primary qualities are rarely characterized according to the early modern model, namely, as explanatorily fundamental in science.[[9]](#endnote-9) The move away from this characterization of primary qualities by philosophers such as Bennett who were primarily focused on commonsense qualities as well as those such as Campbell who were focused on scientific qualities marks a consensus around a new model of primary qualities.[[10]](#endnote-10)

 I’ll call the current model the *interaction-among-objects model of primary qualities*. According to the interaction-among-objects model, primary qualities are any scientific or commonsense qualities involved in causal interactions among objects. As noted earlier, this model straightforwardly builds on the early modern model by simply expanding the concept of primary quality to include non-fundamental qualities that can be explained with respect to the fundamental qualities.

 And despite the change in model, it is still standardly thought that if color is mind-independent, it is a primary quality. The characterization of primary qualities on the current model—as being involved in causal interactions among objects—makes the mind-independence of primary qualities plausible. Thus, being involved in causal interactions among objects is sufficient for the mind-independence of color.

In addition, being involved in causal interactions among objects seems plausibly necessary. It seems plausible that if color cannot be characterized as being involved in causal interactions among objects, but instead must be characterized in terms of perceptual responses, it is mind-dependent. On the face of it, qualities of objects that are not involved in causal interactions among objects, having no wider causal role than the causing of perceptual responses, are mind-dependent. Thus, being a primary quality as characterized by the interaction-among-objects model is plausibly a necessary condition for the mind-independence of color.

I’ll further develop this requirement to specifically address determinate colors (such as blue and purple). Qualitative similarity relations (such as that blue is more similar to purple than it is to green) are central to the way we characterize determinate colors. Thus, the mind-independence of color requires that there is some mind-independent way of describing the qualitative similarity relations. From a scientific standpoint, the interaction-among-objects model requires that color is a natural kind in the following sense: color is a determinable with determinates characterized by qualitative similarity relations that can be described independent of perceptual responses. Assuming that color is a quality of all objects (at least at the macro level) and that the science that best captures this universality of color is physics, the interaction-among-objects model requires that qualitative similarity relations can be described in terms referred to by laws of physics, as opposed to being described in terms—even in disjunctive physical terms—that require appeal to perceptual responses. Thus, according to the interaction-among-objects model, if color is a mind-independent quality, then since it is plausibly a quality of physical objects (given its universality), it is a natural kind of physics.

 Consequently, the broadening of the concept of primary quality brings into consideration non-fundamental physical kinds such as reflectance. Reflectance is non-fundamental; it is a dispositional property of physical surfaces (in particular, to reflect and absorb certain proportions of light across the visible spectrum) that is explained in terms of the microphysical qualities of surfaces. Thus, if color determinates can be identified with particular reflectance determinates, then color is a natural kind of physics, and it meets the requirement for mind-independence. So, a primary quality theory of color might seek to identify color determinates (coarse-grained determinates such as red, or fine-grained determinates such as specific shades of red) with particular reflectance determinates.

 In the next section, I’ll demonstrate the important role played by the interaction-among-objects model of primary qualities in current arguments against the mind-independence of color. I agree with opponents of the mind-independence of color that color is not a natural kind of physics, and so is not a primary quality. In section III, I’ll offer an alternative model of color perception which allows that even though color is not a primary quality, it is mind-independent.

1. Current Arguments Against Mind-Independent Color

 Here is an argument against the mind-independence of color:

(P1) If color is a mind-independent quality of physical objects, it is a natural kind of physics.

(P2) Color is not a natural kind of physics.

(C) Color is not a mind-independent quality of physical objects.

This argument presents at a very general level a line of thinking that is commonly presented against color being mind-independent, and in particular, against color physicalism.[[11]](#endnote-11)

 Different instances of this argument provide different sorts of evidence from color science in support of (P2). However, the relevance of this evidence to supporting the conclusion requires (P1).

For example, Campbell offers evidence from color science to support the claim that color is not a natural kind of physics. His evidence, by now commonly cited in the color literature, includes the variety of micro-physical mechanisms involved with color, metamerism (where metamers are physically distinct color relevant qualities of light or objects that can look the same color in some viewing conditions), as well as the involvement of perceivers’ states of adaptation and viewing conditions (1969, pp. 135-146). But Campbell makes this evidence relevant to the metaphysics of color by claiming that being a natural kind of physics is what’s required for color to be mind-independent. Accordingly, he claims that the mind-independence of determinate colors requires that they be characterized by a pattern of causal interactions among physical objects that is distinctive of that color; thus, for example, red must have a distinctive pattern of causal interactions that differentiates it from blue (1969, p. 136). Assuming that causal interactions among physical objects must be described by reference to natural kinds of physics, the requirement for color being mind-independent is that it is a natural kind of physics.

 C. L. Hardin’s (1990), devoted to developing objections to color physicalism, argues similarly. Asserting (P1) with respect to a version of physicalism that identifies color with wavelengths, Hardin states, “To find out what *looks* yellow, we obviously must attend to the operating characteristics of human visual systems. But the physicalist who would reduce real colors to wavelengths of light should be able to pick out the *real* colors on the basis of physical considerations alone” (1990, p. 557; emphasis in original). By ‘real color’ Hardin means mind-independent color, and his demand that it be characterized in terms of ‘physical considerations alone’ expresses the requirement that color is a physical kind. Hardin offers evidence from color science, similar to Campbell’s evidence, to support (P2).

 Furthermore, the so-called argument from structure against color physicalism is an instance of this general argument. A problem that the argument from structure points out is that there is no physical quality candidate for being color that models the qualitative similarity relations (such as that red is more similar to purple than it is to green, and that purple is a mixture of other colors while red is not). This argument uses evidence from color science to support the lack of such a physical quality candidate, and, as I’ll argue, it makes this evidence relevant to the metaphysics of color by appeal to (P1).

 The argument from structure has been stated by both proponents and opponents of color physicalism (for a proponent’s statement and a defense of physicalism, see, Byrne, 2003; for opponents’ treatments see Hardin, 1993, pp. 65-66; McGilvray, 1994, pp. 201-203; Clark, 1996, S145-S146; Thompson, 1995, pp. 122-124; Pautz, 2006; also see Cohen’s 2003 where he defends physicalism without endorsing it). I’ll focus on Adam Pautz’s 2006 presentation of the argument against reflectance physicalism (which identifies colors either with particular reflectances or with disjunctions of reflectances) because its target includes a version of physicalism that makes an appeal to qualities of visual experience, and this version of physicalism is similar to the alternative I’ll propose in Section III.

 Pautz’s presentation has three premises: first, that color structure claims are true (so, for example, it is true that blue is more similar to purple than it is to green); second, that the color qualities blue and purple are intrinsic and non-relational qualities; and third, that reflectances are not similar to each other in ways that model color structure claims. Evidence from color science supports the claim that reflectances are not similar to each other in ways that model the color structure claims. Thus, reflectance physicalism implies that color structure claims are false. But since the color structure claims are true, reflectance physicalism is false (2006, pp. 538-540). (Furthermore, there isn’t any other physical quality that’s a candidate to identify with color that does model the color structure claims. So although the argument rejects reflectance physicalism, it applies to any identification of color with a physical quality.)

 However, why think that reflectance physicalism implies that the color structure claims are false? Taking a physicalist view that holds that specific shades are *disjunctions* of particular reflectances, a specific shade of blue and one of purple is each a disjunction of particular reflectances. A proponent of this view would claim that the disjunction identified with the shade of blue is qualitatively similar to the disjunction identified with the shade of purple simply because blue is qualitatively similar to purple. Evidence from color science indicates that this would not be a relation found at the physical level. But what relevance does that have to the metaphysics of color?

 Pautz and others presenting the argument make the evidence from color relevant to the metaphysics of color by way of the claim that if color is a mind-independent quality of physical objects, it is a natural kind of physics. The argument assumes that if physical qualities model the color structure claims, then the physical quality with which the shade of blue is identified is *physically* similar to the physical quality with which the shade of purple is identified. But if similarity relations among colors are described in terms referred to by laws of physics, as opposed to being described in terms that require appeal to relations between physical qualities and perceptual responses, then color is a natural kind of physics. (Also see Matthen, 2005, pp. 197-200, and Ross, 2001, pp. 44-46, for this point.) Thus, the argument from structure assumes that the mind-independence of color requires that it is a physical kind, as demanded by the interaction-among-objects model of primary qualities.

 Yet, rejecting (P1), color physicalists who identify color with disjunctions of physical qualities don’t pick out these disjunctions by way of laws of physics. Instead, the disjunctions are picked out by perceptual states of color. Pautz calls this physicalist strategy for meeting the demands of the color structure claims the experiential account. According to the experiential account, color structure is not explained by relations among colors themselves, but rather among qualities of visual experiences of color (2006, p. 536).

Pautz objects to this account as well, however. By including the premise that color is an intrinsic and non-relational quality, Pautz’s argument is set up to respond to the experientialist account. He presents a dilemma for physicalists who accept color structure claims. The physicalist must either: (1) account for color structure claims by way of physical kinds, or (2) account for them by way of qualities of visual experiences of color. Option (1) fails because no physical kind models the color structure claims. Furthermore, Pautz offers a number of points against (2), including that, by contrast with what (2) indicates, what makes the color structure claims true are colors themselves—intrinsic and non-relational qualities of physical objects as according to his second premise—not relations between qualities of physical objects and color experiences (2006, pp. 549-553).

 However, I’ll argue that it’s possible to reject both (1) and (2), and maintain that colors are physical qualities of objects that are disjunctive from the standpoint of physics. Pautz’s dilemma assumes that there are only two ways that color structure claims are made true: either by qualities referred to by laws of physics or by qualities of visual experience. In section III, I’ll offer a third alternative that develops the idea of a physical quality that isn’t a natural kind of physics. This third alternative provides a reason for thinking that (P1) is false.

1. An Alternative Understanding of What the Mind-Independence of Color Requires
2. Color perception as a filter

 The third alternative is that colors are physical qualities at a higher level than physical theory. In order to explain what I have in mind by higher-level physical qualities, I’ll describe what I’ll call the *information filter model* of color perception.[[12]](#endnote-12)

 To introduce the information filter model of color perception, I’ll first make some points about filters, and in particular distinguish object filters from information filters. I’ll then use information filters to model color perception.

 Generally speaking, filters take some physical input, and differentially treat input on the basis of its various physical qualities, giving an output that includes some, but not all, of the input according to these physical qualities. (Some filters do more, for example, electronic filters can amplify; however, I intend for my general description in terms of inclusion and exclusion to capture a core function of something we would typically call a filter.)

 Preliminarily, it’s useful to see how a filter model is promising with respect to color perception. A basic question regarding color and color perception is whether we can separate the perception of color, and in particular the mental qualities of visual experience, from the nature of color. As I’ve argued, the current standard assumption is that if the nature of color is wholly separate from the perception of color—thus if color is mind-independent—then color must be a natural kind of physics. But I’ll show that according to the filter model, this assumption is misguided about the nature of color and its relation to visual experience.

 Consider that filters transform what they receive as input into output by way of selective inclusion and exclusion principles. What this transformation allows is that input qualities are natural kinds of physics, and output qualities result from the application of inclusion and exclusion principles. Take, as a very simple example, use of wire mesh for filtering pebbles by size into larger and smaller. Input qualities are the pebbles’ determinate sizes, and output qualities are the result of application of inclusion and exclusion principles; for a single mesh, the output qualities are larger and smaller.

 Larger and smaller aren’t natural kinds of physics—that is, qualities that are referred to by laws of physics don’t tell us where to draw the line between larger and smaller. They are qualities determined by the filter. Yet the filter doesn’t create larger and smaller as non-physical qualities. Instead, the qualities larger and smaller encompass ranges of determinate qualities (such as particular sizes) that are natural kinds of physics. These determinate qualities are first-level physical qualities; since larger and smaller encompass ranges of first-level physical qualities, I’ll call them *higher-level physical qualities*. This simple example provides a suggestion of the possibility that mental processing involved in color perception need not be creating non-physical (for example, mental) qualities, but instead is accessing higher-level physical qualities.

 *Object filters* perform this input-output function with physical objects or physical energy (such as light or sound waves) on the basis of the various physical qualities of objects or energy. So, for example, a sound filter takes sound as input and produces output by differentially treating it on the basis of its various frequencies, including some, but not all, frequencies in output.

 The wire mesh for filtering pebbles is another example of an object filter. Because its workings are simple, I’ll use the wire mesh as a representative object filter to introduce some terminology. I’ll call the determinate size of a particular pebble that pebble’s *maximally determinate size*, and I’ll call the filter-imposed sizes (larger and smaller) *filter determinates*. Given input pebbles with maximally determinate sizes, the filter functions to differentially treat input on the basis of various maximally determinate sizes to produce an output that divides pebbles by coarse-grained size. Thus, the filter causes pebbles with an indefinitely wide variety of maximally determinate sizes to be sorted into the coarse-grained sizes of filter determinates: larger and smaller.

 Due to the filter’s role in imposing the filter determinates larger and smaller, these filter determinates can be used to refer to qualities of both the filter that does the sorting and the pebbles sorted. However, since these qualities are very different, it’s important to use different terms in referring to qualities of the filter and qualities of the filter’s output. I’ll call the filter determinates (such as larger and smaller) of filters *media qualities*. I’ll call the filter determinates (such as larger and smaller) of pebbles *filter-accessed qualities*. (By calling these qualities filter accessed, I am stressing the point that they exist independent of filters even though we don’t find these qualities independent of filters.)

 Because my pebble filter example involves only one wire mesh, it doesn’t highlight the usefulness of terms applied to the filter. But consider a combination of two wire mesh filters to separate small, medium, and large pebbles. In this case, it’s useful to distinguish between the filters themselves as small and medium. And at the same time the importance of the distinction between filter-accessed qualities and media qualities becomes clearer. The filters don’t instantiate filter-accessed qualities. The wire mesh itself isn’t the small, medium, or large of the pebbles. Instead the wire mesh filters have media qualities—the apertures of different sizes—that pick out these filter-accessed sizes by imposing boundaries among objects with a wide variety of maximally determinate sizes.

 An *information filter* is different from an object filter in that its filtering function involves processing information about objects and their qualities. Thus input and output are carriers of information about objects and qualities, not the objects and their qualities themselves about which information is carried. Carriers of information can be qualities of neural states, or qualities of physical energy such as light (which, of course, I classified as an ‘object’ with respect to object filters; information filters involve objects and qualities that carry information about further objects and qualities).

 Like object filters, information filters perform this input-output function on the basis of physical qualities, but the physical qualities involved are carriers of information. (See John Kulvicki, 2015, for a very helpful overview of information theory that focuses on perception; in this context, Kulvicki briefly discusses how physical qualities get to be carriers of information.) The filter receives an input carrier of information, such as qualities of light, as the result of a causal relation between light and the particular object or property the information is about, and in the course of processing information the filter functions to produce filter determinates—media qualities—that include and exclude certain information. Thus, as a result of this processing, media qualities such as qualities of neural states are the output carriers of information, that carry information about filter-accessed qualities.

 I’ll now characterize color perception as an information filter. Adopting terminology from David Hilbert (1987), I’ll call the particular reflectances involved in particular causal interactions with perceivers *maximally determinate colors*. According to the information filter model, in the course of processing information about maximally determinate colors, color perception imposes filter determinates such as red and blue. (In describing color perception as an information filter, I am not taking up the question of how the carrying of information is involved in conceptual mental representation. Still, the distinction between color and perceptual responses that carry information about, but do not constitute, color can be used to help establish a distinction between color and mental representations that are about, but do not constitute, color.)

 Filter determinate terms—such as ‘red’ and ‘blue’—can be used to refer to qualities of the filter as well as to physical object qualities picked out by the filter. Thus there is an ambiguity in color terms. ‘Red’ as referring to qualities of visual states or processes are media qualities. ‘Red’ as referring to physical object qualities are filter-accessed qualities. This ambiguity is explained by a correspondence between media qualities and filter-accessed qualities with respect to qualitative relations. Thus, for example, the media quality red corresponds to filter-accessed red because it’s qualitatively related to the media quality blue and other media qualities in the way that filter-accessed red is qualitatively related to filter-accessed blue and other filter-accessed qualities. (For this ambiguity in color terms, as well as this way of explaining how the mental state and physical object families of qualities are related, see Rosenthal, 1985; 1999; 2005, chapter 7, section IV, especially pp. 197-198; and 2016, section III).

 What, in turn, explains this correspondence between the media qualities and the filter-accessed colors is that the media qualities impose boundaries among a wide variety of maximally determinate colors. The qualitative relations among filter-accessed colors are those to which the media qualities give access by imposing the boundaries they do. This explanation of the correspondence is an alternative to an explanation according to which the media quality red and the filter-accessed red of physical objects share what it’s like to be conscious of red. On the filter model of color perception that I’m proposing, the red of which we are conscious when there is something it’s like to be conscious of red is always filter-accessed red (I argue for this claim by way of arguing for phenomenal externalism in my [forthcoming]).

 Even though the same term—such as ‘red’—applies to media and filter-accessed qualities, it is thus important to distinguish these applications. The visual system itself doesn’t instantiate the filter-accessed colors about which it processes information. When we perceive red, the visual system doesn’t take on the filter-accessed color red—we don’t perceive the *visual system* (or parts of it) as the filter-accessed color red. But the visual system does have processes that produce neural states with media qualities. The producing of media qualities involves applying inclusion and exclusion principles that impose boundaries on information carried by qualities of light about maximally determinate colors; these boundaries make it so that neural states with media qualities carry information about ranges of maximally determinate colors. Thus, having neural states with a certain media quality carries information about the filter-accessed color red. Referring to the media quality in terms of the quality it carries information about, the media quality is called red, but the media quality is not itself filter-accessed red.

1. A new take on what the mind independence of color requires

 With respect to the relation between the filter and filter-accessed qualities, consider again the pebble filter. When a wire mesh filter sorts pebbles it imposes filter determinates, such as small, medium, and large. The media quality small—the filter determinate of the filter itself—isn’t a natural kind of physics. The media quality small is explained by utility (in the case of a human designed filter). And the filter-accessed quality—the quality of pebbles being small—is not a natural kind of physics. However, the filter-accessed quality is a physical quality in at least one sense: it is a range of maximally determinate sizes as picked out by a filter. The range is not logically or metaphysically tied to the filter; the range exists independently.

 Likewise, media qualities involved in color perception (such as those of a normal human visual system) are not natural kinds of physics. They are the products of evolution. And a quality such as the filter-accessed color red is a range of maximally determinate physical kinds—such as reflectances—as picked out by the visual system. And likewise, this range is not logically or metaphysically tied to the filter.

 From the standpoint of the information filter model of color perception, what the mind-independence of color requires is simply that filter-accessed color is not logically or metaphysically tied to perceptual responses. Furthermore, since this is plausibly a sufficient condition for mind-independence, if filter-accessed color meets this condition, it is plausible that filter-accessed color is mind-independent.

 However, because color has no wider causal role than the causing of perceptual responses, it might seem filter-accessed color is in fact logically or metaphysically tied to perceptual responses. Thus, to make the mind-independence of color plausible, it is important to explain why, despite the lack of a logical or metaphysical tie to perception, color has no wider causal role than the causing of perceptual responses.

Yet, the information filter model does explain this. It allows us to understand that even if the nature of color is wholly separate from perceptual responses, colors are qualities we wouldn’t find apart from having those perceptual responses. The filters that pick out filter-accessed colors are quite crude (with only three sorts of cones in normal human color perception). As a result, the qualities accessed by them do not correspond to natural kinds of physics, and filters are needed to get access to them; you (or anything else) wouldn’t bump into them without a filter. But then the qualities accessed are only involved in causal interactions with filters, in particular biological creatures with visual systems or artificial systems set up to mimic aspects of biological visual systems. Thus, although the metaphysics of filter-accessed color and the epistemology of these qualities are related (the filter is needed to get access to the quality), filter-accessed color is not at all constituted by perceptual responses, as it is often assumed.

 The reliance on primary quality models to tell us whether color is mind-independent is not the only obstacle to accepting the claim that color is mind-independent. For example, I’ve avoided the question of how mind-independent color relates to what it’s like to be conscious of color. (However, Ross, forthcoming, addresses this question by way of the information filter model. The basic idea is that color perception, as an information filter, provides us with access to external physical qualities that are qualitative independent of consciousness and perception, and that such external physical qualities are necessary to explain what it’s like to be conscious of color.) Yet even at this point, it is possible to outline some helpful ways in which the filter model of color perception could change thinking about color.

 Assuming (as is currently standard) that the mind-independence of color requires that it is a natural kind of physics, it seems that those who claim that color is mind-independent are committed to say that color perception aims to identify physical kinds. However, the evolutionary plausibility of the aim to identify physical kinds is questionable (see Gary Hatfield, 1992 for this point). But by rejecting this standard assumption about what mind-independence of color requires, the filter model of color perception avoids this sort of objection.

 Furthermore, revisiting the idea that blue and purple is each a disjunction of maximally determinate reflectances, we can say that the disjunction with which blue is identified is qualitatively similar to the disjunction with which purple is identified because blue is qualitatively similar to purple. While these qualitative similarities aren’t modeled by physical similarities among physical kinds, they are modeled by similarities among higher-level physical qualities. Media qualities carry information about physical qualities that are at a higher level than physical theory (meaning they selectively include and exclude information about ranges of maximally determinate colors), and so have the effect of finding qualitative similarities that aren’t evident at the level of laws of physics.

 Also, different types of visual systems find different qualitative similarities, and thus different colors. The encoding of information about physical qualities like reflectance is constrained by a creature’s adaptive needs. The inclusion and exclusion principles involved in the producing of media qualities are adjusted according to this constraint.[[13]](#endnote-13) Different types of creatures have visual systems with different adjustments, and these different adjustments result in imposing different boundaries on information carried by media qualities. Different boundaries then result in the finding of different qualitative similarities.

 Maximally determinate reflectances have qualitative relations among each other. But being crude filters, evolved color vision systems can’t find those qualitative similarities, and instead tune into qualitative similarities among ranges of maximally determinate colors—that is, among higher-level qualities. Since different creatures have different media qualities, the same maximally determinate reflectance can be encoded by different media qualities’ encodings involving disparate ranges of maximally determinate reflectances. For each different encoding, the maximally determinate reflectance is part of a different higher-level quality. And different media qualities that set different boundaries on information find different systems of qualitative relations among different higher-level qualities. But while the maximally determinate reflectance might be part of different higher-level qualities, since it isn’t by itself a higher-level quality, it itself isn’t in multiple qualitative similarity relations among different higher-level qualities. By itself, a maximally determinate reflectance is only in the qualitative similarity relations with other maximally determinate reflectances.

 By distinguishing media qualities and filter-accessed colors, we can see how media qualities play a role in picking out colors of physical objects, where the colors of physical objects are physically constituted, but the explanation of the media qualities by which these physical qualities are picked out comes from evolutionary biology, not physics. This distinction allows us to come to a better understanding of how the mind is involved in determining the colors we see as an epistemological matter, even though colors are physical qualities of objects.

1. Thompson and the Current Arguments Against Mind-Independent Color

 One of Thompson’s major contributions to the philosophical and scientific debate about the nature of color and color perception is his adept use of historical views to diagnose current problems (Thompson, 1995, Ch. 1). The focus of Thompson’s diagnostic endeavor is the early modern account of perception which he calls the received view. At the core of the received view is a causal chain: (1) physical objects have physical properties which cause light to be reflected from them; (2) light reflected from physical objects cause perceivers’ sensory organs and brains to go into certain neurophysiological states, and (3) neurophysiological states cause perceptual experiences of properties such as color and shapes which perception attributes to physical objects (Thompson, 1995, pp. 10-13, p. 27).

 Thompson shows that the early modern description of perception according to this causal chain has had a powerful influence on our framing of problems of color and color perception now. He notes a current tendency to approach the problem of the nature of color as being a choice between either identifying color with properties of objects or identifying color with properties of perceivers’ sensory responses (or, alternatively, between color being in the world or in the head). And he claims that this tendency is a result of dividing the causal chain between (1), an external part involving physical objects’ reflectance, and (2), an internal part involving perceivers’ physiological and psychological responses (Thompson, 1995, pp. 26-27; also see Westphal, 1987, pp. 151-156, for this diagnostic claim).

 With this diagnosis, Thompson calls for rejecting the received view’s description of perception, and turning to an alternative, which he claims is:

…a philosophically sensitive treatment of the world-dependence of the mind and the mind-dependence of the world evident in the perception of color. Thus, in contrast to the extreme views currently favoured [namely, physicalism and subjectivism], I argue for a relational account: colours are properties constituted jointly by the perceiver and the world (1995, pp. xi-xii).

Thompson contends that this alternative’s relational account of both perception of color and color itself allows us to avoid the received view’s framing of problems, and in particular, its sharp distinction between the external realm of the world and the inner realm of the mind. According to Thompson, color perception and color itself are understood as highly complex relations characterized by evolutionary biology and ecology that can’t be summarized by a neatly segmented causal chain. Thompson’s alternative seems to offer a scientifically enlightened route out of a tired philosophical standoff regarding the subjective/objective dichotomy. Indeed, color scientist and philosopher Mazviita Chirimuuta takes up Thompson’s historical diagnosis as motivation for a relational account of color that she sees as building on Thompson’s relational view of color (2015, pp. 39-40, p. 49, p. 68, p. 133).

 But Thompson’s rejection of color physicalism assumes that if color is mind-independent, it is a primary quality. Against physicalism, Thompson offers the argument from structure (1995, pp. 122-124; Thompson attributes it to Hardin and calls it the argument from external irreducibility). His premises include evidence from color science: “External, perceiver-independent physical properties, such as lightwaves and spectral reflectances, do not admit of such divisions [into unique and binary hues]” (1995, p. 123).[[14]](#endnote-14) And how is this empirical evidence made relevant to the metaphysics of color? Thompson states in another premise: “…if hues are to be reductively identified with perceiver-independent, physical properties, these properties must admit of corresponding unique and binary divisions,” He makes it clear that “corresponding unique and binary divisions” among physical qualities are modeled by relations among physical kinds (1995, p. 124). But then this premise assumes that if color is a mind-independent quality of physical objects, it is a physical kind, and so is a primary quality as understood in terms of the interaction-among-objects model. Since the interaction-among-objects model of primary qualities develops from the early modern model in a straightforward way, Thompson’s falls into the trap of early modern thinking on which I’ve focused.

 This trap distorts what Thompson understands as the subjective/objective dichotomy as well as his estimation of the plausibility of color physicalism. Falling into it, color can be objective (that is, mind-independent) in only one way: as a natural kind of physics. And, as a result, he claims that physicalists are committed to the idea that color perception aims to identify physical kinds. Considering that this is evolutionarily implausible, Thompson offers a relational account of the perception of color and color itself.

 Yet while color *perception* is, as Thompson claims, is an immensely complex relation between the perceiver and the world, where this relation has developed through evolution, color is not. The information filter model separates color perception and color itself in a way that allows for the objectivity of color without it being a physical kind.

 Color perception is a relation with an epistemological purview with respect to color. This relation involves perceivers with media qualities, but media qualities are aspects of a filter that provide access to, but do not constitute, filter-accessed qualities. Which filter-accessed colors are picked out is subjective in the sense that this is determined by the perceiver’s media qualities (and different individual human perceivers and different types of animals have different media qualities). But the filter-accessed colors picked out are objective; the blue of physical objects is as mind-independent as the smaller of pebbles. Even so, filter-accessed colors aren’t physical kinds, as primary quality models claim. The mechanical philosophers’ influential assumption that the mind-independence of color requires that it be a primary quality has been a mistake.[[15]](#endnote-15)

References

Anstey, Peter R. (2000). The Philosophy of Robert Boyle. London: Routledge.

Armstrong, D. M. (1968a). “The Secondary Qualities,” *Australasian Journal of Philosophy*, vol. 46, No. 3 (December 1968): 225-241.

Armstrong, D. M. (1968b). *A Materialist Theory of the Mind*. London: Routledge.

Armstrong, D. M. (1987). "Smart and the Secondary Qualities," in *Metaphysics and Morality:*

*Essays in Honour of J. J. C. Smart*, eds. Philip Pettit, Richard Sylvan, and Jean Norman. Oxford: Basil Blackwell, 1-15. Reprinted in Byrne & Hilbert, 1997a, 31-46.

Atherton, Margaret (1991). “Corpuscles, Mechanism, and Essentialism in Berkeley and Locke,” *Journal of the History of Philosophy*, vol. 29, no. 1 (January 1991): 47-67.

Bennett, Jonathan (1965). ‘Substance, Reality, and Primary Qualities’, American Philosophical Quarterly, vol. 2, no. 1 (January 1965): 1–17.

Bennett, Jonathan (1971). *Locke, Berkeley, Hume: Central Themes*. Oxford: Clarendon Press.

Byrne, Alex (2003). “Color and Similarity,” *Philosophy and Phenomenological Research*, vol. 66, no. 3 (May 2003): 641-665.

Byrne, Alex and Hilbert, David (eds.) (1997a). Readings on Color, vol. 1, The Philosophy of Color. Cambridge, MA: MIT Press.

Byrne, Alex and Hilbert, David (eds.) (1997b). Readings on Color, vol. 2, The Science of Color. Cambridge, MA: MIT Press.

Campbell, Keith (1969). “Colours,” in *Contemporary Philosophy in Australia* edited by Robert Brown and C. D. Rollins. London: George Allen & Unwin Ltd., 132-157.

Campbell, Keith (1972). “Primary and Secondary Qualities,” *Canadian Journal of Philosophy*, vol. 2, no. 2 (December 1972): 219-232.

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

Clark, Austen (1996). "Commentary: True Theories, False Colors," in *Proceedings of the 1996 Biennial Meeting of the Philosophy of Science Association*, Part I, Contributed Papers, ed. Lindley Darden, S143-S150.

Cohen, Jonathan (2003). “On the Structural Properties of the Colours,” *Australasian Journal of Philosophy*, vol. 81, no. 1 (March 2003): 78-95.

Descartes, Rene (1984). *Sixth Meditation* in *The Philosophical Writings of Descartes*, Vol. II, edited by John Cottingham, Robert Stoothoff, and Dugald Murdoch. Cambridge: Cambridge University Press, 50-62.

Descartes, Rene (1984). *Sixth Set of Replies* in *The Philosophical Writings of Descartes*, Vol. II, edited by John Cottingham, Robert Stoothoff, and Dugald Murdoch. Cambridge: Cambridge University Press, 285-301.

Downing, Lisa (1998). ‘The Status of Mechanism in Locke’s Essay’, The Philosophical Review, vol. 107, no. 3 (July 1998): 381–414.

Evans, Gareth (1980). "Things without the Mind—A Commentary upon Chapter Two of

Strawson's *Individuals*," in *Philosophical Subjects: Essays Presented to P. F. Strawson*. Oxford: Clarendon Press, 76-116.

Galilei, Galileo (1989). *The Assayer*, in *The Scientific Background to Modern Philosophy*, edited by Michael R. Matthews. Indianapolis: Hackett Publishing Company, 56-61.

Hardin, C. L. (1990). “Color and Illusion,” in *Mind and Cognition: A Reader*, edited by William G. Lycan. Basil Blackwell, Oxford, pp. 555-567.

Hardin, C. L. (1993). *Color for Philosophers: Unweaving the Rainbow*, Expanded Edition. Indianapolis: Hackett Publishing Company.

Hatfield, Gary (1992). "Color Perception and Neural Encoding: Does Metameric Matching Entail a Loss of Information?" in *Proceedings of the 1992 Biennial Meeting of the Philosophy of Science Association*, Vol. 1, Contributed Papers, eds. David Hull, Micky Forbes, and Kathleen Okruhlik, 492-504.

Hilbert, David R. (1987). *Color and Color Perception: A Study in Anthropocentric Realism*. Stanford: CSLI.

Hobbes, Thomas (1839). *Concerning Body*, in *English Works of Thomas Hobbes of Malmesbury*, Vol. I. London: John Bohn.

Hunt, David M., Livia S. Carvalho, Jill A. Cowling, Juliet W. L. Parry, Susan E. Wilkie, Wayne L. Davies, and James K. Bowmaker (2007). “Spectral Tuning of Shortwave-sensitive Visual Pigments in Vertebrates,” *Photochemistry and Photobiology*, vol. 83, no. 2 (March-April 2007): 303-310.

Jesseph, Douglas M. (2004). “Galileo, Hobbes, and the Book of Nature,” *Perspectives on Science*, vol. 12, no. 2 (Summer 2004): 191-211.

Johnston, Mark (1992). "How to Speak of the Colors," *Philosophical Studies*, vol. 68, no. 3 (December 1992): 221-263. Reprinted in Byrne & Hilbert, 1997a, 137-172. Page numbers refer to reprint.

Kalderon, Mark (2007). “Color Pluralism,” *The Philosophical Review*, vol. 116, no. 4: 563-601.

Kulvicki, John (2015). “Information Theory,” in *The Oxford Handbook of Philosophy of Perception*, ed. Mohan Matthen. Oxford: Oxford University Press, 734-754.

Locke, John (1975). An Essay Concerning Human Understanding, ed. Peter H. Nidditch. Oxford: Clarendon Press.

Matthen, Mohan (2005). *Seeing, Doing, and Knowing: A Philosophical Theory of Sense Perception*. Oxford: Clarendon Press.

McGilvray, James A. (1994). "Constant Colors in the Head," *Synthese*, vol. 100, no. 2 (August 1994): 197-239.

McGinn, Colin (1983). *The Subjective View: Secondary Qualities and Indexical Thoughts*. Oxford: Clarendon Press.

Pautz, Adam (2006). “Can the Physicalist Explain Colour Structure in Terms of Colour Experience?,” *Australasian Journal of Philosophy*, vol. 84, no. 4 (December 2006): 535-564.

Peacocke, Christopher (1984). "Color Concepts and Color Experiences," *Synthese*, Vol. 58, No. 3 (March 1984): 365-381. Reprinted in Byrne & Hilbert, 1997a, 51-65. Page numbers refer to reprint.

Rosenthal, David M. (1985). “Review of *Perception: A Representative Theory* by Frank Jackson,” *The Journal of Philosophy*, vol. 82, no. 2 (January 1985): 28-41.

Rosenthal, David M. (1999). “The Colors and Shapes of Visual Experiences,” in *Consciousness and Intentionality: Models and Modalities of Attribution*, ed. Denis Fisette: Dordrecht: Kluwer Academic Publishers, 95-118.

Rosenthal, David M. (2005). *Consciousness and Mind*. Oxford: Clarendon Press.

Rosenthal, David M. (2016). “Quality Spaces, Relocation, and Grain,” in *Sellars and His Legacy*, ed. James R. O’Shea, Oxford: Oxford University Press, 149-185.

Ross, Peter W. (2001). “The Location Problem for Color Subjectivism,” *Consciousness and Cognition*, vol. 10, no. 1 (March 2001): 42-58.

Ross, Peter (2015). “Primary and Secondary Qualities,” in *The Oxford Handbook of Philosophy of Perception*, ed. Mohan Matthen. Oxford: Oxford University Press, 405-421.

Ross, Peter (forthcoming). “Phenomenal Externalism’s Explanatory Power” *Philosophy and Phenomenological Research*.

Smart, J. J. C. (1975). “On Some Criticisms of a Physicalist Theory of Colors," in *Philosophical Aspects of the Mind-Body Problem*, ed. Chung-ying Cheng. Honolulu: University of Hawaii Press, 54-63. Reprinted in Byrne & Hilbert, 1997a, 1-10.

Smith, A. D. (1990). ‘Of Primary and Secondary Qualities’, The Philosophical Review, vol. 99, no. 2 (April 1990): 221–254.

Thompson, Evan (1995). *Colour Vision: A Study in Cognitive Science and the Philosophy of Perception*. London: Routledge.

Watkins, Michael (2010). “A Posteriori Physicalism,” *Philosophical Studies*, vol. 150, no. 1 (August 2010): 123-137.

Wilson, Margaret D. (1992). ‘History of Philosophy in Philosophy Today; and the Case of the Sensible Qualities’, The Philosophical Review, vol. 101, no. 1 (January 1992): 191–243.

1. Thus, I’m approaching history in a way that Margaret Wilson describes as “…see[ing] how traditional and still influential conceptions of philosophical problems may be bound up with assumptions that require fresh evaluation today” (1992, p. 194). [↑](#endnote-ref-1)
2. I’ll assume a description of natural kinds that applies to qualitative determinables: a determinable quality is a natural kind of physics if its determinates can be described by qualitative similarity relations among qualities referred to by laws of physics. This disallows that qualitative similarity relations among determinates require appeal to perceptual responses. [↑](#endnote-ref-2)
3. I’ll assume throughout my discussion of the primary-secondary quality distinction that it relates to qualities of the natural world, thus the relevant qualities of matter are natural qualities, as opposed to qualities of artifacts (such as the quality of being a jacket; cf. Smith, 1990, p. 227). [↑](#endnote-ref-3)
4. There were, of course, deep epistemological disagreements among early modern theorists. For example, Descartes claimed that our understanding of primary qualities is independent of perception; he claimed that we have a perception-independent grasp of the mathematically describable essence of matter, and in particular of extension and other primary qualities. By contrast, Locke claimed that our understanding of primary qualities is dependent of perception, and on this basis denied that the essence of matter is accessible to the human mind. Thus, Margaret Atherton argues that with respect to the claim that primary qualities are essential to matter, “although Locke accepted the essentialist model as an account of what is to be explained, he thought our faculties inadequate for developing explanations in its terms” (1991, p. 50). I’ll limit my characterization of primary qualities to a point of agreement, namely that they are explanatorily fundamental for all material qualities, setting aside the question of whether the human mind is capable of figuring out the explanations. [↑](#endnote-ref-4)
5. I take a reductive explanation of a quality to be an explanation in terms of more basic qualities. In Book II, Ch. 8, Sections 23-24, Locke claims that the power of the sun to melt wax is dependent on the primary qualities of the sun, and this power is manifested in changes in the primary qualities of the wax. [↑](#endnote-ref-5)
6. For more discussion of the early modern background for the current debate about the primary-secondary quality distinction, see Ross (2015). [↑](#endnote-ref-6)
7. This distinction between the physical bases of dispositions to produce perceptual responses and the dispositions themselves, along with the admission that the dispositions themselves cannot be described in terms of causal interactions among objects, is commonly noted by dispositionalists (see, for example, McGinn, 1983, p. 15; Johnston, 1992, pp. 148-150). [↑](#endnote-ref-7)
8. Armstrong and Smart were interested in the nature of color, and how it fits into a physicalist account of the world, rather than the primary-secondary quality distinction per se. Because Armstrong and Smart claimed that color is a mind-independent quality of objects, they can be viewed as denying that color is a secondary quality. However, Armstrong (1968a, 1968b Ch. 12, and 1987) referred to mind-independent colors as secondary qualities. Armstrong explained that though the term ‘secondary quality’ “suggests particular views as to the nature of these qualities,” including views he rejected, “the term is so usual that it would be inconvenient to employ any other” (1968a, p. 225). The version of physicalism that I’ll support in Section III is Smart’s (1975) view, which Armstrong took up later (for example, in his 1987), according to which color is, from the standpoint of laws of physics, a disjunctive physical quality. [↑](#endnote-ref-8)
9. However, A. D. Smith maintains that characterizing primary qualities as explanatorily fundamental continues to be important, contesting that: “…the contemporary discussions of the primary-secondary quality distinction are in a state of disarray and out of touch with their historical origins” (1990, p. 222). He insists that we either “ditch the term ‘primary quality’, or use the term to advert to the properties deemed fundamental by current science” (1990, p. 253). But Smith’s insistence is misguided. The primary-secondary quality distinction does still get attention; so ditching the term ‘primary quality’ would miss something of current interest. Furthermore, Smith doesn’t explain why adequate appreciation of the historical origins of the distinction requires that primary qualities be explanatorily fundamental in science as opposed to qualities involved in causal interactions more broadly. [↑](#endnote-ref-9)
10. For at least some early modern theorists, commonsense explanation was not as clearly differentiated from scientific explanation as it is now. Anstey (2000, pp. 54-58) points out that for Boyle, commonsense qualities such as size, shape, and motion, are well suited to scientific explanation. Wilson (1992, pp. 225-226 and pp. 235-236) offers this point with respect to Locke. Thus, it might be best to think of Bennett as emphasizing the commonsense aspect and Campbell as emphasizing the scientific aspect of explanation, where early modern theorists saw less differentiation. [↑](#endnote-ref-10)
11. This argument can also be used against realist color primitivism, the claim that color is an irreducible quality of physical objects; furthermore, realist color primitivism, like physicalism, rejects (P1). I’ll focus on the argument against physicalism, however, and I won’t enter into the debate between physicalism and realist primitivism here.

 But in the context of arguing for realist primitivism against physicalism, Michael Watkins (2010, p. 125) categorizes both realist primitivism and physicalism that identifies color with disjunctions of physical qualities as primary quality views. Since color according to these views doesn’t have a causal role wider than causing perceptual responses, his model for primary qualities isn’t the interaction-among-objects model. Instead, his usage indicates a third model according to which primary qualities need not have a wider causal role than the causing of perceptual responses. I have no objection to this use of the term ‘primary quality’, although, of course, I claim that the interaction-among-objects model is still dominant. In response to Watkins’s query as to why primitivism is unpopular (2010, p. 124), I’d say that it is because it’s not easy to make plausible that colors are mind-independent but not identified with physical kinds—a challenge for both his realist primitivism and physicalism—in part because of the influence of early modern thinking. [↑](#endnote-ref-11)
12. The idea of color perception as an information filter is broadly similar to the view about color perception called selectionism (see Kalderon, 2007). Also, it fits well with Mohan Matthen’s Sensory Classification Thesis (2005, pp. 13-14), and in particular Matthen’s example of the ball-sorting machine (from Friedrich A. Hayek) (2005, pp. 16-17). In Ross (forthcoming), I draw a further distinction between information filters that are internalist and those that are externalist, and I present the externalist variety in order to support phenomenal externalism. [↑](#endnote-ref-12)
13. Indicating how sensitive color perception is to selection pressure, Hunt, et al. (2007) state that the substitution of a single amino acid of a pigment’s opsin protein can (in certain species, for example, cows) determine whether the pigment’s peak sensitivity is in the violet or the ultraviolet (p. 304, p. 308). (In cows, substituting tyrosine with phenylalanine at site 86 of the shortwave-sensitive SWS1 pigment’s opsin shifts this pigment’s peak sensitivity from violet to ultraviolet. Thus a gene that coded for phenylalanine instead of tyrosine at this site would shift the pigment’s peak sensitivity from the violet to the ultraviolet.) Hunt, et al. (2007) also state that shifts in shortwave-sensitive pigments from ultraviolet to violet peak sensitivity have occurred many times in vertebrates, with birds shifting back to pigments with ultraviolet peak sensitivity (p. 304, pp. 306-307). [↑](#endnote-ref-13)
14. A ‘binary’ hue is one such as purple that is a mixture of other hues; a ‘unique’ hue is one such as green that is not a mixture of other hues. These qualitative relations among colors are stated in color structure claims. [↑](#endnote-ref-14)
15. I’m very grateful to an anonymous reviewer, as well as Derek Brown, David Hilbert, Mohan Matthen, and the Cal Poly Pomona work-in-progress group, and in particular Katie Gasdaglis and Alex Madva, for helpful comments. [↑](#endnote-ref-15)