

Color Relationalism and Perceptual Error

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Color relationalism holds that colors are relations between perceivers, surfaces, and viewing conditions. Cohen [7] provides a novel and extensive defense and elaboration of the view. I believe Cohen's brand of relationalism faces grave problems because it fails to characterize color experience as a form of perception and because it mischaracterizes errors in color perception as errors in judgment. Beyond this, I believe Cohen's account of such errors relies on a theory of linguistic and mental representation of color that does not work. In what follows, I first present the data about perceptual variation that motivates relationalism and Cohen's arguments in favor of the theory. In the second section of the paper, I argue that Cohen's relationalism is inconsistent with the theory of representation central to contemporary perceptual psychology because it fails to account for error in color perception. In the final three sections, I attempt to show that the theory of representation that Cohen's account of errors in judgments about color relies on is not a tenable one.

1 Perceptual Variation and Color Relationalism

Cohen proposes color relationalism as a means of accommodating various forms of perceptual variation. Variation in color perception occurs whenever there is a phenomenological difference in the appearance of a surface that cannot be explained by a change in the way that surface reflects light on to the retina. Such discrepancies can occur as a result of some features of the environment of a perceiver, or the nature of the perceiver's visual system. In the latter case, Cohen cites intrapersonal and interpersonal differences in visual system, as well as interspecies differences.

Some effects of the environment on the phenomenology of color experience are rather straightforward. For instance, the proximal stimulus responsible for color experience - the array of light that strikes the retina - can vary in wavelength across the visible spectrum, and sufficient difference at any wavelength at any region of the retina will be registered and result in a distinct phenomenology. There are two possible sources of such variation - variation in the propensity of a surface to reflect or absorb light of a visible wavelength, and variation in the intensity of ambient light of a visible wavelength. That the former is sufficient for a difference in color is uncontroversial. Cohen takes the latter sort, variation in illumination, to be sufficient for a difference in color as well.

We ought to pause and take note of how strange this claim is - when I take

a ripe, red tomato out of the grocery store on a sunny day, there is a change of several hundred times in the intensity of light it reflects toward my retina for any given gaze at the fruit. But I still see the fruit *as the same color*. Of course, the contracting of the pupils in order to adjust to the greater intensity of light offsets some of the potential phenomenological difference due to environment. But the examples are countless - the effect of a lamp shining on just a portion of a white wall creates a phenomenological difference in viewing some portions of that wall. Cohen counts these as differences in color.

Categorizing such phenomenological phenomena in this way flies in the face of contemporary perceptual psychology, which takes its central data to be forms of constancies, capacities to re-identify features of the environment despite changes in proximal stimulus [5, 408]. In the case of color vision, the question is how we are able to identify a surface as having the same color despite radically different arrays of light striking the retina in different environments. Doing so involves the visual system's distinguishing and separately estimating illumination and reflectance in the environment, suggesting that a visual state represents illumination and color - contrary to Cohen's assumption that phenomenological discrepancies caused by differences in illumination are differences in color.

Paradigms in science are not sacrosanct, and we can regard them with suspicion when they entail serious conceptual or empirical difficulties. Perhaps we can regard Cohen's arguments for relationalism as an indictment of the current paradigm in perceptual psychology. But I will argue in the following section that this paradigm provides us with a robust conception of representation that Cohen has failed to provide. According to the conception of representation that I will argue for, one for which there does not appear to be any plausible rival, color relationalism is wholly untenable.

In any case, there are further, perhaps more compelling examples of perceptual variation. On the intrapersonal level, there are examples in which a surface can appear differently depending on the reflectance properties of the surfaces surrounding it in the environment. Cohen [7, 20-22] provides several examples in which colored patches, identical in isolation, appear to have distinct color depending on which of several colored patches surround them. An additional interesting example of this sort of variation is the checkershadow illusion [2]. In this illusion we see a cylinder on top of a grey and white checkerboard, casting a shadow over the board. It can be demonstrated that a particular white square falling under the shadow and a black square that remains outside the shadow, can, in other contexts, appear to be the same color.

On the interpersonal level, there are variations according to race and ethnicity and age, as well as chromosomal variation. Macular pigmentation absorbs short-wave light before it reaches the retina, affecting the intensity with which some cones in the retina are stimulated. The degree of macular pigmentation co-varies with levels of melanin-production in the skin, meaning that people who naturally have fairer skin receive more short-wave light to the retina than those who naturally have less fair skin [10, 113-116]. Macular pigmentation also becomes more pronounced with age (Ibid.).

Photoreceptor peak sensitivity varies according to one's chromosomes. Those with a Y chromosome belong to one of two groups, whose peak long-wave cone sensitivities differ by between 5 and 6 nm, while half of all of those with two X chromosomes have peak long-wave cone sensitivity between those two groups. These variations in photoreceptor sensitivity result in differences among groups about judgments about whether two surfaces match in color. In a typical experiment, subjects adjust red and green lights so that they match another, orange light. Those of the median group mentioned above tend to see the 'matches' of the extreme groups either as 'too red' or 'too green' [13].

A study cited by Hardin [9, 68-69] as demonstrating the nonexistence of such a thing as a 'normal subject', references Hurvich, Jameson, and Cohen [12], whose results demonstrate subjects cannot agree on which surfaces have the hue 'unique green', which is a putative shade of green that no more resembles any primary color than another. Block [3, 43] points out that the range of shades that Hurvich et al's 50 subjects identified as 'unique green' span 27 nm and a remarkable 9 percent of the visible spectrum, and judgments range so far that 'unique green' for some was 'unique blue' for others.

The final form of perceptual variation that Cohen invokes in favor of relationalism is interspecies variation. Pigeons have four sorts of photoreceptor (individuating 'sorts' by peak sensitivity), and mallards five. An extra variety or two of photoreceptor means another means additional dimensions of variation in the quality space of an organism possessing extra sorts of photoreceptor. This means the aforementioned birds are able to make color discriminations that human beings aren't. But it also means that most of the qualitative aspects of visual experience that pigeons and mallards have are in all likelihood different than those of humans.

How can we infer this? Color quality space is a space of resemblance and difference - that is, qualia¹ are placed along such a space as determined by *resemblance to* and *difference from* other qualia. If qualia are involved in any instance of color discrimination, then greater powers of discrimination entail further resemblance and difference relations between qualia. Either these resemblance and difference relations supervene on intrinsic qualitative aspects of qualia, or those qualitative aspects supervene on the relations. In any case, it follows that the set of possible qualia that a subject can have is determined in part by structural properties in receptor and postreceptor processing of visual data.

We've shown so far that there is significant variation in the qualitative aspects of any perceiving of a surface, depending on who's looking, their species, and what sort of other surfaces and lighting conditions there are. Cohen argues that this variation must be accommodated by adopting the relationalist theory on the basis of "ecumenicism", the idea that given variation, we cannot privilege any quale or any sort of experience as the 'correct' or 'characteristic' one for any color. Given any disagreement in perception, we face a trilemma: we can

¹By 'qualia' here I only mean the different possible aspects of the qualitative character of experience, whether these are representational properties of experience, properties of external surfaces, or some nonrepresentational mental entities.

choose one subject's representation as veridical, no subject's representation, or all of them. Cohen claims the first option is unacceptably arbitrary and potentially "chauvinistic", and the second option simply denies that color exists. This leaves the final option, that all subjects party to a disagreement in color qualia have veridical representations.

To say more about this first option, consider the fact that among the representation of color varies along racial and ethnic lines, according to one's chromosomes, and with age. If one thinks there is a correct qualitative character which represents color, then one must be prepared to say which sex, which races and ethnicities, and which ages see the 'right' colors. It seems not only arbitrary, but as Cohen claims, chauvinist, to claim that one must be a certain sex, race, ethnicity, or age to see color correctly. The claim extends naturally to species, as well, though perhaps a bit more contentiously.

The alternative possibility that Cohen [7, 89-94] considers is that a difference in quale is a difference in the *mode of presentation* of some property. This leaves open the possibility that a surface of unitary color may cause distinct qualia in different viewing conditions, in different subjects, or in different species, since the qualitative variation will simply be a difference along some parameter in the way one and thing same property is presented in perception.

Cohen rejects this proposal as a means of avoiding relationalism for what seems to be the reason that every property has certain modes of presentation that present the property 'as such', while others do not. For instance, Cohen (2009: 92) asks us to consider "a round dinner plate", which "can be perceptually represented as oval when seen from certain angles," but "represented as round when seen from other angles." There are, Cohen claims, two features present in the content of perception that should be distinguished: the shape of the plate, and a mode of presentation of the shape for a perceiver. When one sees the plate as oval, there is an oval mode of presentation in one's perceptual contents, as well as the property of roundness that the plate in fact has (Ibid.).

That a round plate could appear oval requires that there be a "distinguished" mode of presentation for ovalness, and that it could appear to be round requires a "distinguished" mode of presentation for roundness [7, 93]. While we can see that a dinner plate is round when it is presented as oval, we do so under a canonically oval mode of presentation. When we look at the plate from above, on the other hand, we see it as round under a canonically round mode of presentation. It's worth noting that here, like above, Cohen is ignoring a form of perceptual constancy, though: in this case, shape constancy. There may be a phenomenological similarity between a round plate seen at a slant and an oval plate seen head-on, but it is wrong to say that a round plate is seen as oval when seen at a slant. The plate looks different because it is represented as being at an angle - if it were seen as oval, the visual state would be illusory.

Suppose, contrary to this fact, that Cohen is correct, and a round plate seen at an angle is seen as oval. The question Cohen proposes is whether we can say the same thing in the case of variations in color perception. Essentially, Cohen is claiming that the trilemma that arises in the former case must arise even if we appeal to modes of presentation, because modes of presentation always purport

to present some property or other. And, while we may see that an object has a property by way of any number of modes of presentation, some of those modes of presentation may, ‘as such’, be ‘of’ *other* properties. This means that appealing to modes of presentation requires us to make the same sort of arbitrary choice that has already been found so undesirable, since, for no apparent good reason, it counts some groups of people in some cases as seeing the ‘wrong’ colors.

Cohen proposes that the best “ecumenical” metaphysics of colors is one according to which colors are relations between subjects, surfaces, and the other parameters according to which variation is found, e.g. environmental factors. He seems to indicate that he takes features of a subject’s visual system, properties of the surface, and environmental factors to be the only parameters included in such a relation, though it isn’t clear that this need be so. In any case, for the purposes of exposition, we can assume that relationalism holds that colors relate perceivers, surfaces, and relevant environmental factors.

Cohen [7, 182] further specifies his preferred form of relationalism as one which identifies the relation in question: an object x is red (yellow, blue, etc.) to S in C just in case x is disposed to cause, in the usual way color experience is produced², red (yellow, blue, etc) experiences for S in C . A red experience, here, is “a type of mental state of subjects? whose tokens are the (typical) effects of those subjects’ attending to red things.” The ‘typical effects’ of attending here may be understood in a number of ways - a representational state, a neural state, or an irreducible feature of phenomenology [7, 194]. Experiences of yellow, blue, and so forth may be characterized analogously.

2 The Problem of Error

The hallmark, the central feature, of representation is that it has the potential for inaccuracy. Not every instance of representation need have such potential - there are sentences that express tautologies, for instance - though I will argue that every *perceptual* state type must have such potential. Moreover, any acceptable theory of representation must account for the possibility of misrepresentation. [8, 298] puts this desideratum forward as a way of capturing the nature of an “non-derived representational capacity”, that is, a representational capacity not had in virtue of some other, as well as from mere information, which means “something... without any assistance from us” and means something “independent of the way we interpret” it (Ibid).

Dretske [8, 298] gives many examples of mere (non-representational) information:

Water does not flow uphill; hence a northerly flowing river means there is a downward gradient in that direction. Shadows to the east mean that the sun is in the west. A sudden force on the passengers

²So as to rule out illusions brought about by nonstandard causes, e.g. by a surgically-implanted electrode.

in one direction means an acceleration of the train in the opposite direction.

These ‘natural signs’ are “more or less reliable indicators... underwritten by certain objective constraints, certain lawful relations, between the sign... and the condition that constitutes its meaning....” (Ibid.) These relations need not be lawful in every case of a natural sign:

It is partly the fact, presumably itself not lawful, that animals... do not regularly ring doorbells while foraging for food that makes the ringing bell mean that someone (i.e. some person) is at the door. If animals changed their habits (because, say, doorbells were made out of nuts), then a ringing doorbell would no longer mean what it does.

But, given that animals have the habits they do, a ringing doorbell does carry information that someone is at the door.

A natural sign’s carrying information is distinct from representation just because there is no capacity for error in the former. The informational connection between a river’s flow and change in elevation holds because the two are found together; if dynamical laws didn’t guarantee this, the connection wouldn’t exist. If a second source of light comparable to the sun existed within sufficient distance of the Earth, we could not rely on the splay of shadows on the ground to indicate the Sun’s position in the sky, and the information connection between the two would be broken. And so forth. Error in these cases simply implies the informational connection no longer exists - not that a ‘mistake’ has been found in nature.

Representation is different. We make false assertions, we have false beliefs, and our perceptions are illusory. In these cases a signifying relation between a sign and the way it indicates the world as being holds no matter whether the world is the way indicated. Not every representational state per se must be capable of being mistaken - my belief that all dogs are dogs will likely not turn out to be false - but among perceptual states in particular there is good reason to think that each is susceptible of error.

Perceptual systems are a kind of sensory system. Sensory systems are a sort of biological system in an animal that is sensitive to the surrounding environment. Phototropism in plants is caused by sensory information, viz., sensitivity to light. Burge [5, 318] provides several examples of mere (i.e. non-perceptual) sensory discrimination in the animal kingdom: “light sensors in *Euglena* (flagellated protozoa), sensitivity in paramecia to certain concentrations of sodium chloride, the contact sensors in flat-worms, shadow sensors in molluscs, proprioceptive feedback in dragonflies” and so forth. The sensitivities carry information about the environment - that is, they create a state in the organism that covaries with the environmental feature in question, and they cause some part of the organism to react appropriately [5, 316]. Stimulation of one of these sensory systems is a natural sign of the environmental factors it is sensitive to.

Perceptual systems are sensory systems, but they are not mere sensory systems. Proximal stimulation, e.g. stimulation of retinal photoreceptors by light, bears an informational relation to one's visual state, but the visual state bears a *representational* relation to certain ostensive features of the *distal* environment. In the ideal case, the state is veridical and the features are not merely ostensive, but actual; otherwise the state is not veridical. Representational features of one's visual state are representations of the environment, not the state of the retina itself.

Visual perception is representational and not merely sensory because the relation between a visual state and the way it represents the world can fail to obtain. This is possible because the proximal stimulus, the array of light that strikes the retina, is a function of the ambient light in a perceiver's environment - specifically, the intensity of light at each wavelength - and the propensity of surfaces in the environment to reflect or absorb that light. The intensity of light that strikes the retina at each wavelength across the visible spectrum can be caused by infinitely many combinations of ambient light and surfaces. So, the possibility of failure arises when the visual system attempts, fallibly, to recreate environmental conditions from a proximal stimulus that underdetermines that environment.

The respects in which the functioning of a perceptual system serves to solve underdetermination problems are manifold, including, in the case of vision, the transformation of a two-dimensional pattern of retinal stimulation into a three-dimensional representation of the environment [5, 344], distinguishing slant from texture and convexity from depth [5, 355, 359], the aforementioned problem of distinguishing environmental illumination from surface reflectance properties, and many more. Solving these problems involves "systematic transformations from sensory registrations to representational states that are distinctive to specific environmental conditions." [5, 399] Transformations consist partially in "systematically neglecting aspects of sensory registration that are not likely to correlate with environmental conditions, and capitalizing on aspects that are likely to correlate, in order to form states that represent specific environmental conditions." [5, 398] In other words, the visual system represents the environment by estimating the *likely* features of the environment, given the current state of the retina.

This picture of the distinction between information and representation, and between merely sensory and perceptual systems, represents a paradigm of mainstream perceptual psychology [5, 342-346]. It also shows why any given visual representation must have the capacity for error - a visual representation is always the product of the visual system's estimation of the distal environment based upon an informational source that does not uniquely determine the features of that environment - as mentioned, the underdetermination problem in vision has infinitely many solutions.

Ecumenicism as an approach to resolving problems of perceptual variation requires us to reject this way of distinguishing representation from information and perception from mere sensation, along with the concomitant paradigm in perceptual psychology. Cohen [7, 23-24] characterizes ecumenicism as holding

that in cases where there is variation in the way a surface is experienced as colored, “there is no principled criterion for favoring one variant over the others,” that is, that there is no good reason to hold that some kind of color experience is veridical and some other kind not, for any given surface. A realist ecumenicist like Cohen concludes on the basis of variation that all ways of experiencing a surface as colored are veridical. Hence there are perceptual states, visual representations of color, that cannot fail to be veridical.

One must wonder, in this case, what makes color experience representational at all. According to the terminological framework presupposed by contemporary perceptual psychology, the hallmark of representation is the possibility of error, brought about by the visual system’s functioning to represent the perceiver’s environment on the basis of a stimulus that doesn’t fully determine the features of that environment. On Cohen’s theory, color of an object is relative to a person and an environment, fully determined by how the color looks to a perceiver at a time. On Cohen’s view, color experience is always veridical, by definition. If there’s no possibility of error, then, what even makes color experiences representational?

In psychophysical terms, relationalism holds that all that matters to the color of an object is the array of light it reflects on to the retina and the processing by the visual system that results in color experience - any property intrinsic to a surface is not represented in color perception, and the visual system makes no effort to recreate any aspect of the environment when it produces color experience. Color experience in a perceiver is fully determined by the state of its retina. In Dretske’s terminology, color experience looks precisely like a natural sign of the state of one’s retina, rather than a representation of any feature of a surface in the environment.

Cohen identifies the properties represented by color experience as propensities to affect one’s visual state in such-and-such a way, the characteristic, canonical experiences of this or that color. Whatever feature of color experience a surface contributes, the color represented is the surface’s causing that feature of experience in the present environment. The veridicality of color experiences on Cohen’s theory must just be a brute fact, though. He cannot appeal to the nature of color - that to be color X is just to produce the experience in a perceiver as being of color X - to explain why color experiences are always veridical. The reason for this is that he appeals, in the first place, to the ubiquitous veridicality of color experiences in order to establish his theory in the first place. This deserves emphasis: *Cohen’s means of attempting to establish color relationalism requires that the veridicality of color experience, hence its status as representation, is a brute fact.*

For this reason, it is difficult to take seriously the idea that color experience is representational after all on Cohen’s theory. He requires that we replace a metaphysics of representation that forms the cornerstone of perceptual psychology with precisely nothing. Unless Cohen can give us some story about why to think color experience is both ubiquitously ‘veridical’ and representational, aside from the fact that his theory requires it, we have all the reason to deny that ecumenical treatments of variations in color experience permit such expe-

rience to be representational. What we take to be color perception is, rather, color sensation.

This alone ought to be enough for us to drop relationalism search for a new metaphysics of color. Common sense and ordinary language, the nature of color experience, and the study of perception take surfaces to be colored and for experience to represent them as such. Surely Cohen's relationalism is a form of error theory in denying that there is any such property. It admits the existence of dispositions to cause certain sorts of experience, but these are merely sensed by us, and not perceived, contrary to the commonsense notion of color. That the theory locates some property *other* than color and *calls* it "color" is no consolation to anyone not antecedently convinced of relationalism's truth.

It's safe to say that we ought to reject color relationalism. But let's dig deeper. Perhaps even if we, ourselves, want to reject relationalism, we can reasonably disagree with Cohen about the philosophical points made so far against his theory. Perhaps our disagreement is about what facts about color and perception we find primitively, non-rationally compelling. As an exercise in philosophical exploration, let's grant for the sake of argument that these consequences of relationalism are true and see where Cohen can take us.

In order for Cohen to give us a satisfactory 'reasonable alternative' to the commonsense, ordinary idea of what color is, he still has to account for the intuition that we can, sometimes, be mistaken about the color of an object. An unrestricted ecumenical view about color entails that there are no mistakes, though. Cohen is aware of this, and has an account of color errors. He does this by proposing to expand his ontology of colors beyond those relating perceivers, surfaces, and particular environments to relations between *sets* of perceivers, surfaces, and *sets* of environments [7, 108]. Presumably, since the former are dispositions of surfaces to produce a certain sort of experience in a perceiver in an environment, the latter are dispositions to produce some member of a set of sufficiently similar experiences in a perceiver in a set of sufficiently similar environments. Hence these properties are of a kind with the former sort, determinables to those more determinate colors [7, 110].

These determinable properties Cohen refers to as 'coarse-grained colors', in distinction to fine-grained colors that are vary from person to person and environment to environment. The set of perceivers and viewing conditions that we regard as sufficient for predicating any coarse-grained color depend on what is relevant in a given context [7, 108], but in the usual cases we intend to exclude "perceivers who have a receptor structure that is significantly statistically anomalous" and "perceptual conditions under which our discriminatory practices are significantly suppressed relative to statistical norms" are regarded as contextually irrelevant. More generally, a perceiver predicates, for instance, 'redness *simpliciter*' of a surface when "she takes it to be red for perceivers pretty much like herself, in circumstances pretty much like those she normally encounters" [6, 8].

This is where Cohen locates error in cases of ordinary color illusions. If one is in illusion-conducive circumstances, and unaware that one is in such a state, then one is prone to take oneself not only to see the colors one sees, but to

take one's experience to indicate something objective - that is, to be seeing a coarse-grained color that others are also seeing. Cohen [6, 343] explains the error by telling a story about an experimental subject named Sally:

Let it be that Sally the subject is invited to the psychophysics lab and is asked to view the stimulus - a ripe tomato as it happens - under viewing condition C. The stimulus, let us suppose, is red for Sally in condition C. Now, Sally will report that the tomato is red *simpliciter* just in case she takes it to be red for perceivers pretty much like herself, in circumstances pretty much like those she normally encounters. Of course, she thinks she herself is a perceiver quite a lot like herself, and she takes her present perceptual circumstance C to be pretty much like those she normally encounters, so she thinks the tacitly presupposed conditions for the ascription of red *simpliciter* are met. Hence, she represents the tomato as being red *simpliciter*, and reports as much to the experimenter. It turns out, however, that Sally has been fooled: C was constructed by the clever psychophysicist so that (i) C would lie outside the range of perceptual circumstances pretty much like those she encounters, (ii) the tomato's appearance in C to Sally would be entirely distinct from the very same tomato's appearance in perceptual circumstances pretty much like those she encounters, and (iii) there would be no visual clues to tip off Sally to these facts about C.

In this case, Cohen says, Sally would be right to believe that the tomato is red to her. Her error is not that she perceives the tomato as red. Rather, her mistake is to take the tomato to be red *simpliciter* - that is, red for other perceivers like her in the circumstances *she normally encounters*. Her ignorance of the conditions under which she was seeing the tomato mean that she erroneously attributes a certain coarse-grained color to it.

A similar story can be told about another possible source of error: Cohen [6, 343] proposes that the psychophysicists could have manipulated Sally's visual system without telling her, causing her abnormalities in the way she perceives the world. Now, when Sally takes a tomato to be red *simpliciter*, she is mistaken because she is no longer in the class of perceivers like her normal self - she is, at the moment, *not* like her normal perceiving self. So, the coarse-grained color she takes herself to be seeing in the tomato - 'red for perceivers like her normal self in the usual sort of conditions' - is not had by the tomato.

These sorts of error - error about the sort of environment one is in, error about the state of one's visual system - are committed whenever we are under a color 'illusion'. In order that colors be the sorts of things that people can see in tandem, meaningfully agree or disagree about, or even discuss in a public language, color relationalism requires that there be coarse-grained colors. Note that Cohen's account of error still leaves us with the odd sort of error theory mentioned above. He still hasn't shown that we perceive color in the external world at all - he's simply given us a surrogate property that he has chosen to call color, one quite different from what we normally think of as color.

To make matters worse, Cohen’s ‘colors’ - the ones we see and discuss in tandem, anyway, coarse-grained colors - are represented at the level of propositional thought. In fact, propositional thought, rather than perception, is the locus of color representation, because errors in color ‘perception’ are in fact errors in the way colors are represented in propositional thought. Color ‘illusions’ are actually mistaken *inferences*. Coarse-grained colors simply aren’t represented in perception - a contextually-defined, fuzzy, likely very large set of perceivers, for instance, is certainly not part of my visual state when I perceive a color. Add in the multitude of colors I am perceiving at any given time, and it looks like a great many people would have to be represented in the content of my visual state. To put it mildly, this more than strains credulity; charity requires that the representation of color occur at a more abstract level of cognition.

The mislocation of Cohen’s ‘perceptual’ errors becomes even more obvious when we consider an obvious fact: one’s visual system ‘falls for’ illusions *even after one knows that they’re illusions*. One can avoid the mistaken beliefs that Cohen claims are errors in color vision and still have the visual state that represents the world in an unveridical way. Consider the Hermann grid - we all *know* that the spaces at the corner of each square are white, but they continue to appear grey on and off. Propositional thought is irrelevant to the manifestation of the illusion, which occurs within a distinct representational system, vision.

3 Segue

In the previous section we saw that Cohen’s theory requires discarding central features of perceptual systems in order to characterize color experience as a perceptual system. Forgiving him this, we looked at whether his account of error in color perception might otherwise be plausible. It isn’t; it’s not even about perception. In the rest of the paper, I want to continue this exercise by seeing if Cohen’s account of error is even tenable modulo these two fatal flaws in his theory. In order that this be the case, Cohen must give an account of the nature propositional representation of coarse-grained colors, that is, a semantics of linguistic and mental representation of color. For coarse-grained colors to be the subject of representation of any sort, Cohen’s semantics must be correct. If Cohen’s semantics is false, then color ascriptions are either about some property other than coarse-grained colors, or they are just not true. But if the former is the case, then the properties color ascriptions *are* about deserve to be called colors, rather than coarse-grained colors.

Cohen begins by giving a framework around which to build a theory about the linguistic representation of surface color, and applies this framework to mental representation of color as well. He does not specify how the framework is to be fleshed out, but gestures at a few ways it might be, which we will examine below. The core idea here is that sentence that attribute color to surfaces are in some way context-dependent - that they attribute coarse-grained colors to surfaces, and that which such colors depend on which sets of perceivers and viewing conditions are contextually relevant. Just “what perceivers and percep-

tual circumstances count as relevant to the evaluation of [a color ascription] will be in some way governed by the common knowledge and beliefs of the speakers and hearers in the context, but will evolve in accord with” the idea that we “adjust? standards of comparison in a context so as to make true/acceptable the utterances of [our] interlocutors” [7, 117].

To motivate the idea, Cohen [7, 118] provides examples of color ascriptions that are explicitly relativized to features of context, such as “x is yellow for a pigeon when viewed under illuminant D65 at a distance of one meter against a flat achromatic background”, “x is yellow for David Hume”, and “x is yellow in the viewing condition of the store, but not in the viewing condition of my living room”. These explicitly-mentioned parameters are the sorts that Cohen believes are implicitly semantically included in any ascription of color. In general, we say an object is “red *simpliciter* just in case x is red for perceivers pretty much like ourselves, in circumstances pretty much like those we encounter.” [6, 342]

Cohen [7, 106-107] proposes several ways the relationalist can give a semantic theory in which information about the relevant class of subjects and the relevant viewing conditions is taken into account in the truth-conditions of color ascriptions, each involving a form of sensitivity to context that incorporates features of context into the semantic content of the ascription. We could take color predicates to be indexicals. We could hold that a color ascription contains an indexical in its logical form, not phonetically articulated, but present nonetheless, in the structure of the sentence. Finally, we might hold that even though the relevant features of context are not designated by any syntactic constituent of a color ascription, by some mechanism they enter the semantic content of an utterance of a color ascription. I believe that each of these approaches is untenable, and intend to demonstrate in what follows that this is the case.

4 Color Attribution and Indexicality

In this section, I will argue that color predicates cannot be indexicals, nor can the hidden-indexical strategy provide relationalism with the resources that it needs. To accomplish both of these I assume, for the sake of exposition, a slightly modified version of Kaplan’s [11] semantics for indexicals. I believe that the considerations I bring against the indexical view can be formulated in terms of other theories of indexicals, but I won’t attempt any such formulation presently. In addition, due to restrictions in space, we will have to forego or constrict discussion of some central features of Kaplan’s framework that are tangential to the present discussion.

Kaplan’s semantics for indexicals makes use of a number of distinctions, primary among these those between *content* and *character*, and between *circumstance of evaluation* and *context of utterance*. The content of a sentence is the truth-evaluable aspect of its meaning, determined compositionally according to the contents of its components. Kaplan [11, 500] gives the example, “I was insulted yesterday.”

If I say [the sentence] today, and you utter the same words tomor-

row, what is said is different. If what we say differs in truth-value, that is enough to show that we say different things. But even if the truth-values were the same, it is clear that there are possible circumstances in which what I said would be true but what you said would be false. Thus we say different things.

What is said, in this sense, is the content of a sentence. Grasping what is said by a sentence allows us to consider whether it is true or false given various ways the world might have been. These counterfactual scenarios are circumstances of evaluation.

The sentence “I was insulted yesterday” can be used to say distinct things because it contains the indexicals “I” and “yesterday”. This is because the content of “I” or “yesterday” depends on some parameter that may vary between occasions of their use. And, since the content of a sentence depends upon its structure and the contents of its constituents, the content of “I was insulted yesterday” depends upon those same parameters. In this case, the one who utters the sentence and the day, respectively - on a different day, said by a different speaker, or both, different contents are expressed.

The dependence upon some contextual parameters must happen in some predictable, specifiable way. There is some common purpose and use to which any speaker puts an utterance of “I” - to self-refer, to mention the person current uttering a sentence. Similarly, when we utter “yesterday”, we do so in order to refer to the day that came before the day the present utterance is being spoken. This function, common to any token of an indexical, is its character; articulated as a rule, it tells us how the content of an utterance of an indexical depends upon the context in which it is uttered³.

The context of utterance, as far as the semantics of indexicals need be concerned, is a possible set of values for the parameters that the indexicals of a language are sensitive to. These include, uncontroversially, the speaker, time, and place of an utterance, as well as a possible world in which those things are situated. So, when we consider a sentence at a context, all the necessary parameters for an indexical phrase to determine some content are fixed; a sentence in a context expresses some content, which can be evaluated at any circumstance of evaluation, including the possible world of the context, as well as any other counterfactual circumstance.

When what is said in uttering a sentence is true in any circumstance of evaluation, it is a necessary truth. For instance, “One less than three is two” expresses a content that is true in every circumstance of evaluation. The content of the sentence is true no matter how we imagine the world might have been. Sentences with indexicals express different contents in different contexts, because their characters determine different contents at different contexts. So they do not unequivocally express necessary truths. But such sentences may still express in every context a content that is true.

³Non-indexical phrases have characters as well, but theirs are “fixed”, i.e., they have no parameters by which contents might vary according to context. Thus non-indexical phrases have the same content in any context.

This is possible because the linguistic rule that the character of an indexical constitutes is linguistically codifiable. The word “I” has no more semantic function than to refer to whoever says it. So the sentence “I am the one uttering this sentence” will always express a true content at any context. The sentence itself will be true whenever spoken, since “I” functions to pick out the speaker, and the sentence predicates *being the speaker of the sentence* of the referent of “I”. This, even though the content expressed is always contingent - that is, there are circumstances of evaluation at which the referent of “I” is not speaking, and perhaps does not even exist.

If color ascriptions have character sensitive to features of the context, then, there should be color ascription sentences that express a contingently true content at every context of utterance, and such sentences should be so just because of the linguistic rules guiding the uses of the color terms. Anyone who can master color terms, then, ought in principle to be able to construct such sentences. Aside from the lack of obvious, or even not-so-obvious, examples of this, there are a few problems with maintaining that the character of a color term is sensitive to sets of perceivers or viewing conditions relevant in the context of utterance.

First, recall the problem of appropriately describing the relation of the color relation. The character of a color ascription, insofar as it is the linguistic meaning of such a sentence, is sensitive to fine-grained distinctions in how contexts are described⁴. That is, whether the character of a color ascription is sensitive to the wavelengths of ambient light in a context, the frequency of ambient light in a context, or neither is a substantive question. Now, suppose we have a color ascription that, when uttered, always expresses a true content, and is so solely in virtue of its semantics. If this sentence characterizes viewing conditions in terms of the wavelengths of ambient light, then the content expressed at any utterance metaphysically-necessarily implies a proposition involving light frequency, rather than wavelength: vice versa if frequency is the semantically relevant feature of viewing conditions.

The trouble is, there is no principled reason why one of these should be the case rather than the other, or that some other feature aside from either should be the one the character of a color ascription should be sensitive to. The problem isn’t just epistemic indeterminacy between two options, either - there are many semantically distinct ways of characterizing viewing conditions, since there are all sorts of metaphysical entailments between causally salient features of viewing conditions - another, for instance, is the relation between microphysical properties of surfaces and their reflectance properties. For any ostensive example of a sentence guaranteed to be true at a context solely in virtue of its character, as a matter of principle it will be an open question whether it, or one of these many metaphysically entailed sentences is in fact true at any context solely in virtue of its character. This speaks to the *practical impossibility* of giving evidence of such sentences.

⁴Although this isn’t obvious from Kaplan’s discussion, see Braun [4] for a persuasive case for regarding character as sensitive to such distinctions.

A more troubling concern is the sort of knowledge that such a semantic theory attributes to language users. Color terms aren't only used by people who have a sophisticated enough understanding of perception and optics to have the idea that there are different kinds of visual system and subject, or that the conditions under which we view colors can vary so radically. In fact, small children are able to master these terms, lending severe implausibility to the claim that the linguistic meaning of a color term is sensitive to sophisticated characterizations of ambient lighting and surface properties. Even worse, it seems plausible enough that infants may think about color. Cohen needs to allow his semantics to apply to thought as well as language in order to account for errors in color perception, so he is committed to the idea that infants represent viewing conditions. Regarding color terms as indexical *overintellectualizes* our linguistic and mental representation of color.

Cohen [6, 12] is aware of this concern and has a few things to say about it. He asks: "Why deny that infants have thoughts about color, or that these thoughts carry such presuppositions" about the relativity of color to a subject's visual system and the ambient optics and reflective properties of the environment. After all, he says, perceptual psychology attributes to infants a commitment "to the principle that objects move in continuous spacetime trajectories, to the principle that causal influence requires contact, and so on" citing Spelke [16].

This response is very weak. For one thing, that a form of representation requires or presupposes that some state of affairs obtains, it does not follow that any part of that state of affairs is thereby represented. It is required and presupposed that the entire universe exists in order that a surface be red, but neither do I represent the entire universe when I represent any surface as red. Less grandiosely, we can note with Taylor [18, 53-54] that a couple's dancing must occur at some location or other - it is a metaphysical requirement, presupposed by any representation of two people dancing. Yet it is not part of the meaning of any phrase of the form 'x danced' that the dancing occurred at a particular location, nor do we represent any location just by entertaining any proposition about people dancing. So any appeal to metaphysical requirements or presuppositions of representation is simply not enough to make Cohen's case.

Cohen might be intending to give a *tu quoque* response in invoking the analogy to perception of dynamics: we claim that the relationalist is overintellectualizing the representation of color, since relationalism requires that infants represent viewing conditions and kinds of perceiver. But then we face pressure to give up the principles by which an infant's visual system represents object motion. It is remarkable that Cohen would think to invoke findings in cognitive psychology whose evidential basis presupposes the very explanatory framework that his theory requires the rejection of. Specifically, Spelke [16] attributes the aforementioned representations of infants on the basis of experiments that assume representational states are brought about by constancy mechanisms, and more generally by the visual system's estimating features of objects in the perceiver's environment. Cohen has no right to evidence garnered on the basis of a theory of representation inconsistent with his own theory.

I do not think the two cases are analogous in any case, though. Attributing

to an infant representation of viewing conditions and kinds of perceiver is over-intellectualizing; attributing to an infant’s *visual system* a certain principles of operation is another story. It is not evident that an infant represents objects as obeying certain rules as that the infant’s representations of motion are made by a visual system that works in tandem with such principles. In any case, the same seems to hold in the case of viewing conditions: the process by which an infant’s visual system estimates luminance and reflectance values in the environment may be describable by reference to features of viewing conditions, but it is mistaken to infer that they are thereby represented by the infant’s visual system, let alone the infant itself.

I conclude that it is implausible that there is any sort of indexicality in attributions of color. It seems impossible in principle to muster a persuasive form of evidence that would demonstrate that color attributions behave analogously to uncontroversially indexical sentences, and the most plausible semantics for indexicals, applied to linguistic and mental representation of surface color, over-intellectualizes such representations by importing too much into their semantic content. In the following section, we move on to another form of context sensitivity that Cohen may try to appeal to.

5 Color Attribution and Unarticulated Constituency

The content of a sentence is evaluated for truth or falsity at a circumstance of evaluation. So, in order to determine the truth or falsity of a sentence at some circumstance, we need to determine its content. In the paradigm case, and in fact most cases, this involves determining the semantic values of the constituents of the sentence and structure of the sentence. A competent speaker of a language can determine from this information the truth-conditions of a sentence of his or her language, the conditions a circumstance must meet in order that a sentence be true at it.

Perry [14, 141-142] proposes a counterexample to the claim that all interpretation of sentences occurs in this manner. Specifically, he proposes that the truth-conditions of a sentence can involve more than the semantic values of its constituents. For instance, the sentence “It is raining” must always be evaluated with respect to a context of utterance, because “raining” refers to “a dyadic relation between times and places”, and the above sentence supplies us only with the time, via the tense of the copula [14, 138]. If I utter “It is raining” while in Santa Barbara, then the content I express has that city as a part, and the city of Santa Barbara plays a role in determining the truth or falsity of what I have said. If I utter the sentence in Santa Cruz, then Santa Cruz is, similarly, a part of the content I expressed.

The above example is contentious, and the existence of unarticulated constituents is a matter of controversy. Cappelen and Lepore [1, 7-9] try to argue for the plausibility that the sentence “It’s raining” expresses the same content in any context, the proposition that it’s raining. Stanley [17] attempts to argue that none of the various classes of sentences mustered in favor of unarticulated

constituents is a clear case in their favor. I am agnostic on the issue, but I regard it as a move of desperation that Cohen would resort to such a contentious postulation. This isn't to say that unarticulated constituents are a desperate move in all cases. The question of truth-conditions for "It's raining" is a good example of a *prima facie* plausible case of unarticulated constituent, but the idea that sets of perceivers and viewing conditions are unarticulated constituents would take a lot of motivating and require the denial to incur serious philosophical costs.

My positive case against the unarticulated constituent view is that it involves a serious ontological cost at precious little motivation. When a sort of phrase has an unarticulated constituent, certain sorts of inference are not licensed. Consider the relation of *noticing*⁵. When one notices something, what's noticed is an essential part of the relation between notice and noticed. If Billy notices that the water on the stove is boiling, and Sally notices that it's sunny out, and it certainly not correct to say "Billy and Sally both noticed". That would require that there be a single noticed-thing that could be the object of both Billy and Sally's noticing, to be the unarticulated constituent of the inferred sentence. Instead, two distinct facts have been noticed.

Now in point of contrast consider the relation of *eating*. When one eats, it is the case no matter what one happens to be eating - the object of the eating relation is not a necessary component of the occurrence of one's eating. This is demonstrated by the implications of instances of eating: if Billy eats an apple and Sally eats coleslaw, we can infer that Billy and Sally both ate. *Having eaten* is a property they share, and this can only be the case if what is eaten in each case is not essential to the property each has in virtue of their partaking in the activity, eating. To state this point in syntactic terms, "to eat" takes no argument - its object is always an adjunct.

Now, what can this show us about color relationalism? Suppose that Billy is a normal trichromat and Sally a shifted trichromat. Suppose further that after each has a 'reddish', but qualitatively distinct, experience of an object, I claim, "Billy and Sally both saw something red." If "to see something red" is a verb phrase of the sort as "to eat", then "Billy and Sally both saw something red" is true because Billy and Sally both had a red-type experience under some set of viewing conditions. Cohen, on the other hand, will say that the sentence is true because both saw the same coarse-grained color. The relevant sets of perceivers and viewing conditions, on the approach under consideration, are part of the content of "Billy and Sally both saw something red" because they are unarticulated constituents of the sentence.

Suppose we extend this solution to more extreme cases. Suppose, for instance, that Sally isn't a shifted trichromat, but rather has an inverted spectrum. Billy and Sally each have an experience of some object as red, but Sally's experience had to be obtained in highly constrained circumstances; perhaps she was wearing special glasses that 're-invert' her spectrum to normal, or some wild lighting effects have transformed the appearance of her environment to the

⁵The following examples of eating and noticing are drawn from Recanati [15, 313-314].

way it would appear in normal lighting to the average perceiver. In this case, is it correct to say that Billy and Sally have both judged the object to be red because there is a coarse-grained color relating a set of perceivers and a set of viewing conditions?

It stands to reason that we determine the membership of each set by its significance for the qualitative character of color experience it lends itself to. Presumably, we say someone perceives a coarse-grained color because the set of perceivers therein related have sufficiently similar experiences in the sorts of viewing condition therein related. In what respect are perceivers whose spectra are inverted relative to one another similar, who could not, in the relevant respects, be more different?

We might stipulate that the color Billy and Sally saw in tandem related a set of perceivers or viewing conditions united by the similarity relation that they could not have been more dissimilar, or that they bore only the minimal similarity that two perceivers can have. These answers are not satisfying; they are ad hoc, serving only to preserve the theory in the face of a *prima facie* objection. In any case, it is highly unlikely that we would naturally group such perceivers together as ‘similar’ in pre-theoretic, commonsense judgments about color perception. Likewise for sets of viewing conditions in which one selfsame perceiver sees the world in such starkly incompatible sets of shade.

Aside from gerrymandering some similarity class in order to construct a color that Billy and Sally see in tandem, we can claim that the relevant set of perceivers includes all human perceivers, and the relevant set of viewing conditions all possible optical environments. The implication here is that there is a ‘universal color’: a way of being colored that every object appears to have in every environment to every perceiver. Moreover, there are some instances, perhaps only in philosophical thought experiments, where we attribute this color to objects. This is bizarre, but it is the cost of the unarticulated constituent view of relationalist representation of color.

Why should we accept this consequence of relationalism rather than reject the theory? Cohen thinks he can motivate the semantic theory by drawing an analogy between color attribution sentences according to relationalism and attributions of motion. Any attribution of motion to an object is only true relative to some frame of reference or another, but frames of reference are usually not explicitly mentioned in attributions of motion to objects. Cohen maintains that “our best metaphysics of motion properties” includes frames of reference as “mandatory relata of those properties” and concludes that sentences used to make such attributions underdetermine “which relational [motion] property is being ascribed”. This line of reasoning is the same he uses to reach his semantic framework for color attribution sentences.

The reasoning is specious, though. Cohen infers from the fact that all motion occurs only relative to some frame of reference that the ‘best metaphysics’ of motion properties has it that every motion property includes some particular frame of reference as a relatum. That is, we individuate motion properties along several axes: velocity, perhaps direction, and, additionally, frame of reference. But this does not follow. It makes at least as much sense not to individuate

motion properties according to frame of reference - I think we would say, in everyday speech, that two objects can each go 60 mph *relative to distinct frames of reference*. If this latter alternative is correct, then particular frames of reference do not enter into the content of sentences ascribing motion. At most, the general fact that an object is moving relative to some frame of reference or other is part of the semantic content of sentences attributing such motion. But we need not even part this much with the apparent form and content of such sentences when we could rather regard the existence of some frame of reference motion is had in relation to as a semantic or metaphysical *presupposition* of the attribution of motion.

I would propose a similar alternative line of reasoning in the case of color experience. Of course when I perceive a surface as red there is a relation that holds between me, the surface, and the environment, the relation that the surface produces the experience characteristic of red surfaces in me in that environment. That ought to be a metaphysical necessity according to any theory of color. But there is absolutely no reason to build this fact into the very semantics of color attributions, because *metaphysical and semantic necessity are two obviously completely different things*. Yet Cohen's attempt to provide independent motivation for his semantic framework seems to confuse the two.

6 Concluding Remarks

Any metaphysics of color has to make sense of perceptual variation. Some forms of variation, such as variations due to differences in lightness, are no philosophical hay for the relationalist. Others, like racial, gender, and age differences in color perception, pose a genuine puzzle in the metaphysics of color. But the ecumenicism driving Cohen's relationalism is not the way to go. It does not account for perceptual error. Where it tries to, it mislocates that error on the level of propositional thought, thereby essentially locating all representation of color as we normally conceive it in that domain rather than in perception, thereby *essentially denying the existence of color perception*. Granting Cohen these already extreme implications of his theory, we cannot even work out a plausible semantics of color attributions and judgments in any of the ways he proposes. In order to save the theory, he is willing to conflate sensation with perception, perceptual with linguistic representation, subpersonal principles of the production of representation with representational facts themselves, and the metaphysical presuppositions of a statement or thought with its representational significance. We can do better than this.

References

- [1] *Insensitive Semantics: A Defense of Semantic Minimalism*. Blackwell Publishing, 2005.
- [2] Edward H. Adelson. Checkershadow illusion, 1995.

- [3] Ned Block. Sexism, racism, ageism, and the nature of consciousness. *Philosophical Topics*, 26(1 and 2), 1999.
- [4] David Braun. What is character? *Journal of Philosophical Logic*, 24:227–240, 1994.
- [5] Tyler Burge. *Origins of Objectivity*. Oxford University Press, 2010.
- [6] Jonathan Cohen. A relationalist’s guide to errors about color perception. *Noûs*, 41(2):335–353, 2007.
- [7] Jonathan Cohen. *The Red and the Real: An Essay in Color Ontology*. Oxford University Press, 2009.
- [8] Fred Dretske. Misrepresentation. In Alvin Goldman, editor, *Readings in Philosophy and Cognitive Science*, pages 297–314. MIT Press, 1993.
- [9] C.L. Hardin. *Color for Philosophers: Unweaving the Rainbow*. Hackett Publishing, 1987.
- [10] Leo Hurvich. *Color Vision*. Sinauer Associates Inc., 1981.
- [11] David Kaplan. Demonstratives. In John Perry Joseph Almog and Howard Wettstein, editors, *Themes from Kaplan*. Oxford University Press, 1989.
- [12] Dorothea Jameson Leo Hurvich and Joseph Cohen. The experimental determination of unique green in the spectrum. *Perceptual Psychophysics*, 4:65–68, 1968.
- [13] Maureen Neitz and Jay Neitz. Molecular genetics and the biological basis of color vision. In John Werner Werner Backhaus, Reinhold Kliegl, editor, *Color Vision: Perspectives from Different Disciplines*. De Greuter, 1993.
- [14] John Perry. Thought without representation. *Proceedings of the Aristotelian Society: Supplementary Volumes*, 60:137–151, 1986.
- [15] Francois Recanati. Unarticulated constituents. *Linguistics and Philosophy*, 25(3):299–345, 2002.
- [16] Elizabeth Spelke. Principles of object perception. *Cognitive Science*, 14:29–56, 1990.
- [17] Jason Stanley. Context and logical form. *Linguistics and Philosophy*, 23(4):391–434, 2000.
- [18] Kenneth Taylor. Sex, breakfast and descriptus interruptus. *Synthese*, 128(1/2):45–61, 2001.