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ORIGINAL RESEARCH

Russellian Representationalism and the Stygian Hues

William A. Sharp[1]

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Abstract
Representationalism is today the leading physicalist theory of the phenomenal character of perceptual experience. And Russellian representationalism, which identifies contents with extensions, is the leading iteration of that theory. If there exist phenomenally distinct experiences as of the impossible, then these would *prima facie* serve as counterexamples to the theory. In order that they definitively serve as counterexamples, it needs to be that there is no plausible account of the experiences on which they decompose into constituent elements each of which is unproblematic from the perspective of the theory. The contention of this paper is that the *stygian color experiences*, afterimage-experiences as of maximally dark, hued surfaces, of Churchland (Churchland, Philosophical Psychology 18:527–560, 2005) serve as counterexamples to Russellian representationalism.

The plan for this paper is, first, in Sect. 1, to get clear on exactly what metaphysically Russellian representationalism is committed to and what motivates accepting it over its rivals. In Sect. 2, we will see why phenomenally distinct experiences as of the impossible serve as counterexamples to the theory barring a plausible decomposition of the associated contents into possible constituents. In Sect. 3, we introduce the stygian color experiences, which, it will be argued, are experiences as of the impossible (Sect. 4) which do not plausibly decompose into possible constituents (Sect. 5). I respond to objections in Sect. 6 before concluding.

1 The target

Representationalism is usually spelled out in terms of supervenience: as saying perceptual phenomenal character supervenes on representational content. This definition excludes "weak" versions of representationalism, which say only that phenomenal character has attendant content but not that it supervenes on content.

✉ William A. Sharp
was775@student.bham.ac.uk

[1] University of Birmingham, Birmingham, UK

Supervenience is most easily understood as a claim about when changes in one type of phenomenon are possible, namely, only when there is a change in some other type of phenomenon. There can be no change in phenomena of type *A*, it says, without a change in phenomena of type *B*. But it might also be explicated in terms of duplication: whenever objects or properties of type *A* are duplicated, so too are the objects or properties of type *B*. We will make use of both construals of supervenience below.

The representational content of a perceptual episode is whatever the episode "says" about the world outside—whatever it says of the subject's environment (or sometimes body). Conjoining supervenience and content thus characterized, we get that representationalism says there can be no change in the phenomenal character of a perceptual episode without a corresponding change in the episode's content. This is representationalism about perceptual consciousness.

There is a long-running question among representationalists about what metaphysical gloss to give to content. Is the content of an experience a Fregean sense, these being intensions or modes of presentation? Or is it a Russellian content, a structured object-property pair (or structured proposition involving objects and properties)? Or maybe it is the set of worlds wherein the experience accurately portrays things. The most popular option today is to identify experiential content with Russellian propositions/object-property pairs.[1] (For ease of illustration, I will speak in terms of object-property pairs. Nothing is lost in doing this.)

One might prefer this view of what content is because one is antecedently attracted to Russellian contents in the case of propositional attitude content. In the case that one is, opting for non-Russellian contents, like sets of possible worlds or Fregean senses, in the case of experience would be to multiply entities needlessly if Russellian contents would do the job just as well. Moreover, insofar as one is antecedently unattracted to non-Russellian contents, she will find non-Russellian versions of representationalism unattractive.

Possible worlds representationalism has fallen out of favor in the last couple of decades. It is the Fregean version of the theory whose popularity rivals that of the Russellian version. The Russellian story about contents is simpler than the Fregean one: the Russellian account posits just extensions as contents while the Fregean account posits extensions and intensions (cf. Chalmers, 2010, p. 361). So, if the complexity of the Fregean story of content can be avoided, then the representationalist should posit the simpler Russellian contents.

Committing to content's identity with Russellian contents gives us the following strand of representationalism about perceptual consciousness:

On this view, when a subject has a visual experience of a red ball before her, the episode's content we can write like so: [that ball, red]. And when she has an experience of an orange cube, we write it [that cube, orange]; and so on.

[1] I follow Chalmers (2010 pp 356–361) in classifying Maund (1995), Holman (2002), Jakab (2003), and Wright (2003) and Thau (2002) as at least compatible with Russellian representationalists. Today, we can add to that list Tye (2009) and Speaks (2015).

1.1 The Constituents of Russellian Contents

A number of considerations over the years have pushed proponents of RR to modify the object-involving portion of the content—of the lefthand side of our transcription of the content. Products off an assembly line, for instance, being qualitatively identical, will induce phenomenally identical experiences in subjects but involve different objects. If Russellian contents are object-involving, then the contents of a series of experiences of the numerically distinct products will be the same in each case. Three visually experienced red balls off an assembly line will induce content [that$_1$ ball, red], [that$_2$ ball, red], and [that$_3$ ball, red], where the demonstratives' subscripts indicate that distinct demonstrative-tokens are used in each case and, so, that different balls are involved in each case. These contents are all different. This has compelled some proponents of RR to replace *that ball* above with an existential generalization with a location-property attached: [there is some ball, red & such-and-such location] (cf. Chalmers's discussion, 2010, p. 358).

But the issue of how best to characterize the object-side of Russellian object-property pairs should not detain us because the problem I will be raising for the theory regards just the property-side (the righthand side) of the content.[2] What matters for us is the following question: What kind of property is *red* in contents like [that ball, red]? And all versions of RR agree on this much: what bracketed 'red' signifies is a property, and the Russellian object-property pair is literally constituted by the property experience attributes to the ball.

1.2 Experience as of the Impossible as a Problem for RR

One sort of counterexample to RR comes from experience as of the impossible. Take, for example, a visual experience of Escher's famous ever-ascending staircase that connects in on itself. Let us call the property of being so arranged *being an Escher staircase*. Because the property *being an Escher staircase* is impossible and, so, exists in no world, the corresponding Russellian content for such an experience would be [*o*, …].[3]

This generalizes. If any experience predicates of some object, *o*, an impossible property, the associated Russellian content of the experience will be [*o*, …]. Why? For now, we will say that this is because if the property exists in no world, then it

[2] Though perhaps it deserves comment that representationalism does not predict what a change in the content of an experience should result in. It predicts only what a change in phenomenal character should result in (namely, a change in content). The two consequences we have just seen of phenomenal character's supervenience on content are that there will be no change in phenomenal character without a change in content and that content-duplicates are phenomenal duplicates. That there should be no change in content without a change in phenomenal character is an unrelated thesis. So, that numerically distinct experiences have different contents does not bear on what the experiences' phenomenal character should be. Accordingly, if there is any advantage to making Russellian contents object-involving, then content-distinct, phenomenally-identical experiences should not deter us from making them object-involving.

[3] I use the ellipsis here to signify that a constituent is lacking in the righthand position of the object-property pairing. Later, where context makes it obvious, I will use ellipses to elide members of a series.

does not exist full-stop and, so, cannot constitute the Russellian content. But we will come back to this issue in the second of the Objections below (Sect. 5).

As it happens, it is no problem for RR if there is only one type of experience which predicates an impossible property of *o*. It is bad if phenomenally distinct experiences do this. This is because if we have two or more phenomenally distinct experiences each with content [*o*, …], then we have sameness of content but distinctness of phenomenology, which our definition of RR explicitly disallows. So, we cannot have two or more phenomenally distinct experiences each without a corresponding property.

And there *are* other experiences as of impossible scenes. Take, for instance, the waterfall illusion, which is a visual experience as of a moving-yet-stationary waterfall. Granting that a moving-yet-stationary waterfall is impossible,[4] the Russellian content of such an experience would also be [*o*, …].

What it's like an undergo the waterfall illusion is distinct from what it's like to see an Escher scene. But the Russellian contents of each experience will be [*o*, …]. The examples, then, give us phenomenal distinctness in the absence of distinctness of content, and, so, *prima facie* serve as counterexamples to RR.

But these are familiar cases that have already been addressed in the literature, and I will be assuming that they can be handled in the following way. Michael Tye, in his (2000), suggests that experiences as of impossible scenes be handled by analyzing their contents, not wholesale, but in a way which respects the content's generation by distinct information channels in the visual pathway. He writes,

> "Given the complexity of the content of visual experience and the number of different channels of information that lie behind its generation, it should not be surprising that in some cases an overall content is produced that is internally inconsistent" (2000, p. 75).

The idea seems to be that the proprietary informational contents of the distinct information-channels implicated in visual information processing will feature directly in the experience-content. And sometimes, as in visual experience as of impossible scenes, these distinct informational contributions come together in such a way that the overall experience-content is contradictory or inconsistent.

Applying this strategy to visual experience of an Escher scene, the idea seems to be that we can say the following. Distinct information-channels implicated in the visual pathway provide, respectively, informational contents I_1,….I_n, where each I_k is internally consistent. But the conjunction of some or all of the I_i is inconsistent or contradictory. Moreover, and crucially, because each of the I_i is possible, there is no risk of the relevant Russellian contents' lacking suitable constituents. So, the content of the Escher experience is [*o*, I_1,….I_n], where there are no gaps to worry about. And the content of a phenomenally distinct experience as of an impossible scene, like the waterfall illusion, will have distinct constituents, [*o*, I^*_1,….I^*_n] where again there

[4] If we do not think the example works, there is a plethora of other shape-examples from which to choose, like the Penrose triangle. And there are even aural examples, like the (aural) barber pole illusion.

are no gaps to worry about. Phenomenally distinct experiences, then, are shown to have distinct contents, and the counterexamples are avoided.

Now, if we had not had these sorts of decomposition stories available to tell, then experience as of impossible scenes, like the two just discussed, would already have successfully served as counterexamples to RR. If RR is a theory worth arguing against anew, then we need to assume that these sorts of decomposition stories are available. What we should be saying, then, is this: phenomenally distinct experience as of the impossible will only serve as counterexamples to RR if no plausible decomposition story, like the ones just discussed, is available.[5] If we have experiences as of the impossible which do not plausibly decompose, then we have a counterexample to RR. In the next section, I will introduce experiences which do just that.

2 Churchland's Stygian Color Experiences

We have just seen that phenomenally distinct experiences that are each as of the impossible would serve as counterexamples to RR unless the experiences' associated Russellian contents plausibly decompose into constituent elements each of which is possible. RR would assign them, in spite of their phenomenal distinctness, identical contents. And RR explicitly disallows such things.

And the contention of this paper is that the *stygian color experiences*, afterimage-experiences as of impossibly dark and yet hued surfaces, of Churchland (2005) give us just this sort of counterexample. RR assigns each phenomenally distinct member of this class of experiences identical contents because each phenomenally distinct such member is a case of experience as of *an impossible color property*. (This will be argued for in Sect. 4.)

And, so, take as two examples stygian yellow and stygian blue experience. These are afterimage-experiences as of something dark-as-black and yet distinctly yellow and as of something dark-as-black and yet distinctly blue. No color property corresponds to either experience type—each is an experience as of an impossible color property.

Inducing these afterimages in your own experience is easy.[6] To induce, e.g., a stygian blue experience, fixate for approximately 20 s on the black crosshair in the yellow circle on the top left of Fig. 1. Immediately afterwards, transfer your gaze to the first black surface to the right, and you should have the experience: an afterimage-experience as of something dark-as-black and yet distinctly bluish. In order to induce stygian yellow experience, fixate for approximately 20 s on the black

[5] As an anonymous reviewer pointed out, even in the example cases given, we might think the decomposition leaves something out: there is a difference between experience of the parts of an impossible scene and experience of the whole scene. We can speculate what sorts of things Tye might say in reply. Perhaps the latter is different for giving rise to a judgement "that cannot be!" which judgment has a specific cognitive phenomenology. I will leave the worry here, though, because I am assuming for argument's sake that the strategy is successful.

[6] Which is to say nothing of the ingenuity it took to predict the experiences.

crosshair in the blue circle of the fourth row of Fig. 1. Immediately thereafter, transfer your gaze to the first black surface to the right and you should have the experience: an afterimage-experience as of something dark-as-black and yet distinctly yellowish. (The rightmost column contains, as it says, "rough predictions" of what your experience will be like. These can only be rough for reasons that will become apparent in Sect. 4.) To induce stygian green and stygian red experience, follow these same instructions on rows 3 and 4. These are the afterimage-experiences that I will be arguing serve as counterexamples to RR. Each is an experience as of an impossible color property.

It is important we know what the neural mechanism is which underpins these afterimages because its operation will be directly relevant to the case to be made in Sect. 5 that no plausible story is available to my opponent on which the stygian color experiences decompose into constituent elements each of which is possible. But a just cursory glance at the relevant science should do. (The reader already familiar with the Hurvich-Jameson opponent-process theory of color experience is advised to skip to the next section, Sect. 4, where the case will be made that RR assigns phenomenally distinct stygian color experiences identical contents.) Knowing just the following five details of the Hurvich-Jameson opponent-process theory of human color experience will suffice for our purposes.[7]

(1) The stygian color experiences are neurally underpinned by the joint activity of three cell-types that are found downstream from retina but early on in the visual pathway: the so-called Blue/Yellow (B/Y), Green/Red (G/R), and Black/White (B/W) color-opponent neurons, each of which can undergo the full range of levels of activation from 0 to 100%, with the default resting state of each cell-type being 50% of full activation (Churchland, 2005, pp. 164–165). (2) The full variety of joint activation-levels of the B/Y and G/R opponent-neurons underpins all experience of *hue* and *saturation*, and the full range of activations of the B/W cells underpins experience of hue *lightness/darkness* (165–166). See Fig. 2 for a diagram of the entire range of human color experiences which result from the full variety of the above three cell-types' joint activations. (3) The stygian color experiences are all underpinned by (i) maximal inhibition of Black/White opponent-cells and (ii) *some* inhibition or excitation of the former two cell-types (179–185). (The former two cell-types cannot be left at their default 50% activation because the satisfaction of (i) but not (ii) underpins experience of the achromatic colors: white, black, and the scales of gray.) (4) It is three retinal cell-types, S, M, and L cones, whose activations affect opponent-neurons, and they respond differentially only to short (S), medium (M), and long (L) wavelength light, with one cell-type designated to each length (*ibid.*, p. 164). And lastly (5) The G/R neurons get inhibited exclusively by M cones and get excited exclusively by L cones; the B/Y neurons get inhibited exclusively by S cones and get excited by both M and L cones but not S cones; and the B/W neurons respond to cones which themselves are sensitive to the amount of light, of any wavelength, impinging on the S, M, and L cones in their vicinity (164).

[7] For a thorough presentation of the relevant science, see Hardin (1988) or Churchland (2005). For details, I rely on the latter presentation.

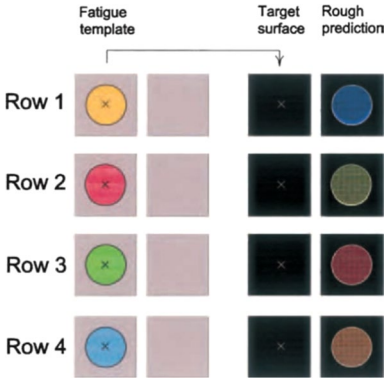

Fig. 1 Aid to produce stygian color experiences. Reproduced with permission from Cambridge University Press

This concludes our very brief look at the opponent-neural machinery which underpins human color experience, including, relevantly for our purposes, the stygian color experiences. We can now move on to the case for the impossibility of the color properties these experiences represent.

3 The Stygian Color Experiences Are Experiences as of the Impossible

In the previous section, we saw how to induce the stygian color experiences in ourselves. We saw that by fixating on colored surfaces for a prolonged period and subsequently fixating on a black surface, we can undergo afterimage-experiences that are maximally dark and yet distinctly hued. These uncanny afterimage-experiences bear on RR because each of them is an experience as of an impossible color property: no object can instantiate maximal darkness and yet also be hued. RR, then, assigns the experiences identical contents—in each case, [*o*, …]—despite their phenomenal distinctness.[8]

In the following Sect. 4.1, I will argue that there is no reflectance property with which the stygian colors are identical. And in 4.2, I will argue that neither are there any primitive color properties with which the colors are identical. This will show that the stygian hues are *metaphysically impossible* qua reflectance property and qua primitive color property. (This leaves open that the stygian colors are possible qua dispositional or relational color properties. I will address the stygian colors' possibility qua dispositional or relational color properties in the Objections and Replies.)[9]

[8] I say "uncanny". But it may just be that they seem uncanny when we place them in the context of expectations we have for colors in broad daylight, for instance. The afterimages may not feel so different from, say, phosphene experiences, which are not unordinary. Note, though, that it only bodes worse for RR if the afterimages do strike us as ordinary, because then RR fails to accommodate experiences that are ordinary.

[9] Churchland provides his own arguments for the stygian color properties' impossibility in the (2005) paper (pp. 182–183). But it suits his aims in that paper to provide what are comparatively informal arguments. Churchland's principal aim there is to show that, in a modest but significant way, physicalists can give their opponents a case of physical facts entailing phenomenal ones. As will be familiar, dualists (like Jackson 1982, and Chalmers 2010) argue that a necessary condition on physicalism's truth is that

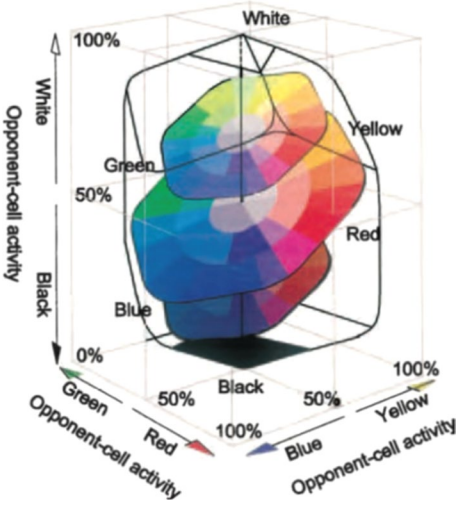

Fig. 2 Range of color experiences and their corresponding activations. Reproduced with permission of Cambridge University Press

Note that these are both physicalist theories of color. I restrict my attention to physicalist theories of color in this way because RR is a physicalist account of perceptual phenomenal character. The contents on which experience supervenes, then, prima facie should be physically constituted too, lest RR lose its claim to physicalism. This is a connection, however, that might be contested. Accordingly, I will consider in the Objections and Replies what the costs are of slackening commitment to the exclusively physical constitution of content.

3.1 Reductionism

On reductionism, the colors are identified with *reflectances*,[10] a reflectance being a measure of how much of the different parts of the visible portion of the

Footnote 9 (continued)
the facts of physics entail the facts about phenomenal character. Moreover, the stygian color experiences' import lies, for Churchland, in their *novelty*. A hallmark of a scientific theory's demonstrated success is the panning out of its novel predictions. And, so, it is not crucial for Churchland's purposes that the stygian hues be genuinely impossible. He only needs that they be the sorts of things one should be surprised to learn of. If they are surprising in this way (for intuitively seeming impossible, we can grant), then the Hurvich-Jameson model's predictive power becomes even more remarkable. It is important for him to make the case for the stygian hues' impossibility only insofar as this underscores their novelty. Accordingly, *I* need to say more to make the case that stygian color properties are metaphysically impossible and that they are metaphysically impossible *qua* reflectance and primitive color property.

[10] Or something thereabouts: Byrne and Hilbert (2003) identify the colors with disjunctions of general tendencies to send light thus-and-so ("send" here being a catch-all for reflectance, refractance, emittance, and the rest). And Churchland (2007) identifies colors with canonical approximation ellipses, a mathematical feature of reflectances that each colors' metamers share (metamers, roughly, being differences in reflectances that subjects cannot detect).

electromagnetic spectrum a surface reflects.[11] There are two intuitive arguments for the stygian hues' impossibility (qua reflectance), which, when taken together, mount a strong case against their possibility. The first says that, given what we should already be saying about when a surface qualifies as maximally dark, or hued, we should want to rule out the possibility of the stygian reflectances on these grounds. The second says that any proposed reduction of the stygian colors would be exceedingly ad hoc and, so, should be avoided.

First, on a metaphysics of color which identifies colors with reflectances, arguably it is legitimate to call an object *dark as black* ("maximally dark") insofar as its reflectance tends towards being flat up against the wavelength axis of its associated graph (cf. Tye, 2000, p. 157; Churchland, 2007, p. 212). The more an object's curve strays from that axis, the more legitimate it becomes to call the object *hued*. And, so, it will be legitimate to call an object both hued and dark-as-black insofar as its reflectance is simultaneously flat up against, and not flat up against, the wavelength axis of its associated graph. I.e., it will never be legitimate to do so. So, it will never be legitimate to call any possible reflectance a stygian color.

Second, the only other candidate reflectances involve reference to portions of the electromagnetic spectrum *outside* the visible range. But identifying the stygian colors with reflectance defined in terms of more of the EM spectrum than the visible range—in terms inclusive of, say, ultraviolet or infrared—would be exceedingly arbitrary, unmotivated, and ad hoc.[12] We should accordingly avoid positing of any reflectance defined in terms of the EM spectrum beyond the visible potion that it is identical with a stygian color.

The upshot is that it is better to think of stygian reflectances as impossible rather than possible. This because, first, their impossibility is suggested by what the reductionist is already advised to say regarding what qualifies as black and what qualifies as hued. And second, because any proposed reduction, ones, say, inclusive of more of the electromagnetic spectrum than the visible range, is bound to be exceedingly ad hoc.

3.2 Primitivism

The stygian colors are also impossible qua primitive color properties. On primitivism, the colors are said to be irreducible physical properties of objects.[13] On this view, the colors are not identical to paradigmatically physical properties—to

[11] There are more ways to be colored than to have a reflective surface—many colored objects do not reflect light but transmit it, refract it, emit it, etc. (see previous note). But it will simplify discussion to consider just reflectances. Invoking the other manners by which an object might send light thus-and-so does not help my opponent, for there is no way at all to be dark-as-black and hued.

[12] It certainly is conceivable (in the sense of conceptually non-contradictory) that stygian yellow is instantiated by objects which reflect radio waves *thus* and the visible portion of the spectrum *so*. But to call stygian yellow possible in light of that is a mistake because it is equally conceivable that *redness* is identical to that same property. This sort of conceivability is not a guide to possibility—at least not in the present context.

[13] The locus classicus here being John Campbell's (1993) paper "A Simple View of Colour".

properties of the so-called scientific image. And yet they are physical. They are physical because they *supervene* on properties of the scientific image—on reflectances, in particular (Byrne & Hilbert, 2006, p. 75). Further, the colors here are not individuated with reference to subjects or subjects' responses. They have their natures independently of their disposition to affect subjects like us in the ways that they do. Finally, on this view the colors are primitive: that is, they are not reducible to any more fundamental physical properties.

Let us work with the example of stygian yellow. Is *primitive stygian yellow* instantiated in any world? We cannot say here, as we did in the context of reductionism, that something is black insofar as its (associated) reflectance tends towards being flat against the wavelength axis of its reflectance profile. Blackness may supervene on flat such curves, but these physical goings on are not a part of blackness's nature. Similarly, we cannot say that something is hued insofar as its associated curve strays from the wavelength axis of its reflectance graph. Colors' natures are distinct from such physical properties. Nevertheless, unpacking primitivism's supervenience claim will allow us to see why primitive stygian colors should not be thought to be possible, either.

In Byrne and Hilbert's seminal (2006) discussion, we see that the primitivist's supervenience claim is spelled out in one of three ways in the literature. On the view, colors are *nomologically coextensive with*, *metaphysically determined by*, or *metaphysically coextensive with* reflectances. On the first construal of the supervenience claim:

> NC) "For any color *c*, there is a [reflectance] P such that P is nomologically coextensive with *c*. Equivalently: it is a law that for every object x, x has P iff x has *c*" (75).

On the second:

> MD) "For any color *c*, there is a [reflectance] P such that P metaphysically necessitates *c*. Equivalently: it is metaphysically necessary that for every object x, if x has P, x has *c*" (*ibid*.).

And on the third:

> MC) "Colors are (metaphysically) necessarily coextensive with [reflectances]" (76).

How do these theses bear on the possibility of the stygian hues? Well, these formulations tie the colors tightly to their supervenience bases. On NC, in order for a primitive stygian color to be instantiated in a world it needs a reflectance to instantiate it. This is a consequence of the thesis's 'iff' connective. The third fleshing out of the supervenience claim, MC, also makes it so that primitive stygian colors will not be instantiated absent some reflectance or other. This is a consequence of the coextension of colors and reflectances. If a color were instantiable in the absence of an underlying reflectance, colors and reflectances would not be coextensive.

The problems with locating primitive stygian yellow in a world if NC or MD is the case are strictly analogous to the case made in the context of reductionism.

First, we said above that we should not think of there as being any reflectances associated with the stygian colors. Because there are no reflectances, neither could there be primitive stygian properties which supervene on those reflectances. And second, positing of any reflectance that stygian yellow is instantiated exactly when it is instantiated is as ad hoc here as it was in the context of reductionism.[14]

However, on the second fleshing out of the primitivist supervenience claim, MD, though reflectances' instantiations will suffice for the instantiation of various colors, the instantiation of primitive stygian colors is not so tightly tied to reflectances. Every world with a particular reflectance has a particular color, yes; but it is not the case that every world with a particular color has a particular reflectance. This gives the primitivist proponent of RR room to hazard that primitive stygian yellow (e.g.) is instantiated by *some property altogether distinct in kind* from reflectances. Can the primitivist exploit this looser connection between color and supervenience base to accommodate primitive stygian colors' possibility?

By my lights, there are three ways she might attempt to exploit this looser connection. She could posit primitive stygian colors' supervenience (i) on actual properties which are not reflectances, (ii) on non-actual properties which are not reflectances, or (iii) on alien properties (which are, perforce, non reflectances). I will address what the problems are with each of strategy in turn.

Here is why the primitivist should not posit primitive stygian colors' supervenience on actual properties which are not reflectances. Take as an example positing that primitive stygian yellow supervenes on massive quarks' decaying into less massive quarks. Hazarding supervenience bases this exotic is ill-advised. If we posit exotic supervenience bases like this, we need to say that in every world that this base property is instantiated so is (primitive) stygian yellow. And no one should think that in the actual world, stygian yellow is instantiated whenever and wherever quarks decay. The example was intended obviously to be strange, but the point generalizes. As before, we should not say that any physical property in the actual world instantiates stygian yellow because we have no reason to think that any property in the actual world correlates with stygian yellow. The general lesson is that the danger of saying primitive stygian yellow is instantiated in any world, w, is that we (on MD) are thereby saddled with positing its instantiation in the actual world wherever the property which underlies its occurrence in w is instantiated in the actual world.

Let us turn to option (ii). Could the primitivist proponent of RR anchor primitive stygian yellow to physical properties that do not exist in the actual world—like, say, the property of being a sphere of gold 100 m in diameter?

Doing that is also unmotivated and ad hoc. If one anchors primitive stygian yellow to the property of being a gold sphere 100 m in diameter, then one is stuck with saying, given the relevant supervenience commitment, that were the property of being a gold sphere 100 m in diameter to be instantiated in the actual world, the sphere would be (primitive) stygian yellow. We shouldn't say this. Further, one would be stuck with saying that in all worlds where the property of being a gold

[14] And as before (fn. 12), conceivability is not a guide to possibility here. It is just as conceivable that redness supervene on whatever property conceivably subvenes primitive stygian yellow.

sphere 100 m in diameter is instantiated, primitive stygian yellow is too. This would be a fact about all those worlds. We could only pretend at having reason to think that the giant, gold spheres of those worlds really are stygian yellow.

And finally, let us consider option (iii). What is the problem with positing primitive stygian colors' supervenience on alien properties. An alien property is one that neither is instantiated in the actual world nor is a combination of any actually instantiated properties. I have no reason to deny that primitive stygian yellow supervenes on alien properties in remote alien worlds. But there is the following problem for this move: alien properties are not physical. Why not? On at least one influential definition of the physical, a property is physical only if it is referred to in fundamental physical theory (Stoljar, 2010, p. 57)—or, I think we should also add, if it is realized by the states/properties referred to by those theories. And alien properties are neither referred to in fundamental physical theory nor realized by the states/properties referred to therein. (We moreover should not anticipate that future fundamental physics advantage itself of properties which neither exist anywhere in the history of the actual world nor might be made by combination of any such properties.) But we call primitive color properties physical because they supervene on physical properties. Primitive stygian colors which supervene on nonphysical alien properties lose their claim to physicality. And this bodes badly for RR because RR is a brand of physicalism. Its proponents, accordingly, will want every perceptual experience to be physical and, so, supervene on the physical. So, the proponent of RR should not have primitive stygian color properties supervene on alien properties.

The verdict, then, is this. We have no reason to say that primitive stygian colors are instantiated in any world. When we say they are instantiated in a world wherever there is physical property P, we are thereby committed, via the supervenience claim of primitivism, to saying this same thing about the actual world: wherever P occurs actually, primitive stygian colors do too.[15] Nothing motivates locating primitive stygian colors in the actual world; any such locating of them in actuality is ad hoc. Moreover, nothing motivates anchoring primitive stygian colors to physical properties that do not exist actually, like the property of being a gold sphere 100 m in diameter, nor on alien properties. To do so would be to make ad hoc claims about swathes of modal space, or it would be to give up on physicalism. We would do better, then, to hold that primitive stygian colors are impossible.

This concludes the argument that the stygian colors, qua property of external object, are impossible. Demonstrating their impossibility gets us halfway to the stygian color experiences' serving as counterexamples to RR. What needs finally to be shown is that no plausible story is available to the proponent of RR whereunder the stygian color experiences decompose into possible constituents.

[15] Cf. also Macpherson (2003): "on an objective physicalist theory, once we have singled out the physical properties that in our world are responsible for colour, those physical properties are the colour properties in all possible worlds. Colour words are taken to refer rigidly to the physical properties so identified….It is crucial to the objectivity of the theory that colour words rigidly refer in this way and that the logical independence of colour properties from colour experiences is maintained" (54–55).

4 The Stygian Color Experiences Decompose at Too Steep a Price

We have said that phenomenally distinct experiences serve as counterexample to RR only if no plausible story can be told whereunder the experiences' contents decompose into constituent elements each of which is possible. And we just saw that the stygian color experiences are as of impossible properties. What remains to be seen, then, is that these contents do not plausibly decompose.

Crucially, two things need to be in place in order that experiences as of the impossible plausibly decompose into possible constituent elements. (1) It must be that there really are distinct information channels responsible for subjects' representing the prized apart content-components. And (2) the properties about which these channels carry information must be possible.

With this in mind, the most natural decomposition of the stygian color experiences treats their contents as being constituted by distinct hue and lightness/darkness components. The most natural decomposition of, e.g., stygian yellow experience sees its content as being constituted by distinct *yellowness* and *maximal-darkness* components: [*o*, yellow & maximally dark].

Opting for this treatment plainly satisfies condition (2): both yellowness and maximal-darkness are possible, as evidenced by the existence of yellow things and black things. What about condition (1)? According to the opponent-process theory of color-experience that we are relying on (Sect. 3), there are indeed distinct information channels involved in stygian color experience (involved in *any* color experience). Particularly, it is one type of cell, the B/W opponent-neurons, which carries information about the lightness/darkness of a hue. And it is two other cell-types, B/Y and G/R opponent-neurons, responsible for information about hue (and saturation). So, the current strategy is at least *prima facie* available to the proponent of RR.

But the problem with this strategy, to put it provocatively, is that if we go all the way with it, *then color experience ceases to be about color*. Less provocatively: If we want to think of each information-channel that has a distinctive informational-profile as contributing a proprietary informational content to the Russellian content of an experience, then the channels which underpin experience of hue (and saturation), these being, recall, the G/R and B/Y opponent-cells, must be prized apart as well. This because they too have distinct informational-profiles, neither of which includes reference to the colors (more on why in the next paragraph). So, once we do think of every channel with its own distinctive informational-profile as contributing different types of content, then the colors no longer feature as constituents in the contents of color experience. And the only thing which could motivate keeping these channels' contributions joint would be a desire to avoid the counterexample. This is to say that experience-content will inevitably be unacceptably gerrymandered if it is to be constituted by hue and lightness rather than all of the informational contributions which would feature in the content were we to fully pursue the current strategy.

To see that the information-channels which underpin registration of hue (and saturation) do not carry information about the colors, consider just the channel

constituted by G/R opponent cells. We saw above that this channel carries information about net differences in long wavelength light versus medium wavelength light impinging on retina (Churchland, 2005, p. 165; see also Tye, 2000, pp. 160–161).[16] But the colors are not identical, nor supervenient on, differences in the long and medium wavelength light that impinges on retina. The colors, we have said, are reflectances, or properties which supervene on reflectances. Moreover, very many things which are not green or red can send *that* light to the eye: blue objects behind yellow films, white objects bathed in green light, white objects bathed in red light, and so on and so forth. So, if we think of the G/R channel as contributing information about these differences in incident light, then the colors no longer feature in color-experiences' Russellian contents. And being forced to take color out of color experience, I will assume, is too considerable a cost for the representationalist to incur.

This response raises the obvious question, Then what *does* carry information about color in the brain? Presumably, the neural activity which carries information about the colors is that activity which underpins color-constancy. And color-constancy cannot be achieved in abstraction from registration of lightness/darkness. That is, constancy is not exhibited absent B/W opponent-cell activity. But once we yoke the informational contributions of B/W opponent-neural activity to the informational contributions of the activity of the cells responsible for experience of hue, we reintroduce stygian color properties into our contents. We are back to assigning identical contents to phenomenally distinct experiences.

The upshot, then, is that we do not have a plausible story to tell whereunder the stygian color experiences decompose into constituent elements each of which is possible. And this lack of plausible decomposition story, in the face of what we established in the previous section, namely, that stygian color experiences give us experiences as of impossible properties, implies that the stygian color experiences serve as counterexamples to RR.[17]

4.1 Recap

Before turning to objections, let us briefly recap how the argument of the previous sections comes together. We have a counterexample to RR when we have phenomenally distinct experiences with identical contents. The stygian color experiences,

[16] The information carried by B/Y cells is slightly more complicated, involving further computations over signals sent from retina (Churchland, 2005, p. 165). But it is true of B/Y cells too that color is not what they inform about. It is the joint operation of the three cells-types—or at least of the G/R and B/Y neurons—that carry information about anything recognizably color-like.

[17] There is now enough in place to explain how my counterexample differs from Macpherson's (2003) example of experience as of red-green. In cognitive neuroscientific work that post-dates Macpherson's article, experience of red-green has been taken to evidence that the hue-solid has distinct dimensions responsible for red and green (Livitz et al., 2011). If that is right, then the proponent of RR could think of these dimensions as being underlain by distinct information-channels and accommodate Macpherson's counterexample that way. So long as the representationalist does not unhitch the B/W channel from the channels responsible for hue, she can prize channels apart like this without taking color out of color-experiences' Russellian contents.

stygian yellow and stygian blue, for instance, are phenomenally distinct experiences with identical contents. These contents are identical because they lack constituents in the same positions: a stygian yellow experience's associated Russellian content would be [*o*, …], and a phenomenally distinct stygian blue experience's associated Russellian content would also be [*o*, …]. And they lack constituents in these same places because, qua relevant property types (reflectances or primitive color properties), stygian yellow and stygian blue are impossible.

The stygian color experiences would not serve as counterexamples to RR if their associated Russellian contents plausibly decomposed into constituent elements each of which is possible. But the stygian color experiences' contents decompose at too steep a price. Their best hope for decomposition comes at the cost of color's ceasing to feature in color experience.

5 Objections and Replies

I want now to consider three objections. The first asks why the proponent of RR cannot slot metaphysically impossible stygian color properties into experiences' associated Russellian contents. The second asks why the proponent of RR cannot slot stygian color dispositions, or stygian color relations, into stygian color experiences' associated contents. And the third asks why the possibility of stygian colors cannot be accommodated by adopting color pluralism.

5.1 Objection: Why Not Appeal to Metaphysically Impossible Properties?

A formerly popular version of representationalism held that experiential content is identical to sets of possible worlds (Lycan, 1996; Tye, 1995). Lycan, in addressing the issue of experience as of impossible scenes, says that the possible worlds representationalist should posit *impossible* worlds to accommodate these experiences (1996, p. 72). The question for us here, then, is whether the proponent of RR can make a similar move.

By my lights, there are at least three broad ways the Russellian representationalist might avail herself of a strategy in this vein. She could (i) accept that metaphysical impossibilities exist and slot metaphysically impossible stygian color properties into the relevant contents; or (ii) accept that the stygian colors are metaphysically impossible but not logically impossible and slot merely logically possible stygian color properties into the relevant contents; or (iii) accept that the stygian color properties are metaphysically impossible and posit their existence in an abstract realm and slot these abstracta into the relevant contents.

5.2 Reply

Depending on other commitments of the Russellian representationalist, she may or may not be able to do this. Whether she can depends on whether she wants to *naturalize content*, in the manner of a teleosemantic or a causal theory of content. (And

these two broad types, I take it, exhaust the externalist's prospects of naturalizing content.)[18] A word, then, on why these semantic-naturalization theses get in the way of employing any of strategies (i)–(iii).

To see why commitment to semantic-naturalization scuppers (i)–(iii), we can abstract away from the considerable differences between teleosemantic and non-teleosemantic causal theories of content. And this because they all have in common the following, quite broad, necessary condition:

> In order for a state *S* of a system *s* to represent external object- or property-type *F*, some *F*s need to exist at some time in the past-present-future of *s*'s environment in order for the *F*s to causally interact with *s* or *s*'s ancestors.

Being metaphysically impossible, stygian color properties exist at no time in the past-present-future of any subject's environment. So, they cannot causally interact with any subject nor any subject's ancestors. Accordingly, neither a teleosemantic nor a non-teleosemantic causal story could account for experience's representing stygian color properties.[19] That is, neither theory-type could accommodate the constitution of Russellian contents by stygian color properties.[20]

However, RR is not wedded to the project of naturalizing content. The proponent of RR could hold that, though content is natural, it is primitive. This would be to endorse a position in the spirit of Burge (2010). In that case, whether she can rely on the constitution of Russellian contents by metaphysically impossible properties depends on whether she is antecedently attracted to the existence of impossibilities. If she is not antecedently attracted to the existence of impossibilities, then relying on them to constitute the relevant contents is an ad hoc expanding of ontology. As a general rule, we should not bloat our metaphysics to accommodate our theories of mind. This, I take it, is a crucial element of the appeal of naturalist/physicalist approaches in philosophy of mind.

This last point goes for each of options (i)–(iii). If we are antecedently attracted to the existence of the impossible, the merely logically possible, or the merely abstractly existent, then we can have it that the stygian hues (qua reflectance or primitive color property) constitute Russellian contents.

This is all to say, then, that if we accept that phenomenal character supervenes on primitive content *and* that this primitive content is constituted by metaphysically impossible properties, then we can avoid the problem posed by the stygian hues. But

[18] There are also structural resemblance/isomorphism accounts, as in Opie and O'Brien (2004), Churchland (2012), Ryder (2004), Shea (2018, Ch. 5). However, with the exception of Opie and O'Brien (2004), these all have selectional or learning histories playing an indispensable role in content's grounding and, so, can count for our purposes as broadly teleosemantic.

[19] Cf. again Macpherson (2003): "[E]ven if we were to allow that in a world with a physics very different to our own there could be colours that do not exist in this world, a teleologist or a causal covariation theorist would have difficulty establishing how experiences must relate to merely possible properties in order for those experiences to represent those properties" (p. 65 fn. 24).

[20] Note that this also blocks the proponent of RR from appealing to color eliminativism to accommodate the case, supposing she wants to commit to semantic naturalization. On color eliminativism, colors appear nowhere in the past-present-future of subjects' environments.

if the proponent of RR is not already attracted to such posits, then perhaps greener pastures lie elsewhere.

5.3 Objection: Why Not Appeal to Stygian Color Dispositions or Stygian Color Relations?

The second objection asks what is keeping us from thinking of stygian color experience as predicating stygian color dispositions, or stygian color relations, of the environment. On dispositionalism, the colors are identical to dispositions to elicit certain color-experiences (see, e.g., McDowell, 1985; Levin, 2000). If there is a world in which object surfaces are disposed to bring about stygian color experiences, then there is a world in which stygian color dispositions exist. The objections of Sect. 4 do not count against worlds like those. So, I should grant the property is possible. It can, then, be thought of as an available constituent of the Russellian contents associated with stygian color experiences. And on relationalism, the colors are identical to triadic relations between subjects, objects, and viewing circumstances (see, e.g., Cohen, 2004), where the subject relatum, importantly, is a highly specified state of visual systems, and the viewing circumstances are highly specified as well (Cohen, 2009, p. 116). On relationalism, stygian colors would presumably be identical to relations between object surfaces, viewing circumstances which include in their specification the over-compensatory activity of implicated opponent neurons, and states of subjects' visual systems which include in their specifications the instantiation of states on the floor of the H-J space (neural states involving the full inhibition of opponent B/W cells). Such relations are instantiated every time subjects have stygian color experiences. Being *actual*, stygian color relations would be readily available constituents of the Russellian contents associated with stygian color experiences.

5.4 Reply

Let us start with stygian colors understood as dispositions. The role of experience in stygian color dispositions makes the dispositionalist metaphysics of color difficult to square with RR. The fundamental characterization of color given by dispositionalism is in terms of color-experience. But the fundamental characterization of color-experience that RR gives is in terms of color. The circularity which results from conjoining these theses is, even if not vicious, at least too tight to be plausible (see Byrne, 2006, p. 225 and Levin, 2000, p. 164 for related complaints).[21] The proponent of RR as I have defined it should not posit the constitution of content by colors construed as dispositions.

Consider now stygian colors relations. This time, it is the role of subjects in stygian color relations that makes the relationalist metaphysics of color difficult to square with RR. In keeping with RR, experience as of stygian colors involves the representation of stygian colors. An initial worry we might have with the

[21] I borrow this way of describing the circularity from Henry Taylor (personal communication).

representation in experience of stygian color relations is that the neural vehicles of the representational contents (again, states on the floor of the H-J space) end up (partly) representing themselves.

To see this, take the vehicles of the contents whose constituents are stygian colors. These will be states on the floor of the H-J space some distance away from the resting points of the B/Y or G/R dimension. On the relational view, these vehicles themselves are partly constitutive of the stygian colors. So, the vehicles' contents include the vehicles themselves. As I see it, Cohen embraces this result (cf. Cohen, 2009, p. 116).[22] But the idea that the neural states involved in perception represent themselves is difficult to square with most of the popular semantic naturalization frameworks, which we got a glimpse of just above.[23] On these frameworks, states' having contents is grounded in the states' causally covarying with distal objects/features. This straightforwardly goes for non-teleosemantic causal theories of content (as we get, e.g., in Fodor, 1987). But it goes for very many teleosemantic theories as well (prominently Dretske, 1988; Neander, 2017; Shea, 2018). Here is the resultant problem. If the vehicles of stygian color contents also constitute stygian color relations, then the vehicles must causally covary with themselves. But nothing causally covaries with itself.[24] So, the vehicles cannot have those contents in a way that can be accommodated by most popular semantic naturalization frameworks.[25]

5.5 Objection: Why Not Appeal to Color Pluralism?

There is this final way the proponent of RR might try to secure the stygian colors' possibility. Color pluralism is the view that it is possible for an object to be distinct colors all over simultaneously (see Kalderon, 2007, for detailed discussion and defense). Pluralism is compatible with reductionism and primitivism, which is important given the ill-suitedness of relationalism and dispositionalism with RR.

[22] Here is Cohen openly committing to the visual system's representing itself:
"In a typical perceptual episode, my visual system will begin by representing the lemon as exemplifying the fine-grained property *yellow for S in C* (where '*S*' is a schematic letter standing in for a relatively detailed specification of my visual system, and '*C*' is a schematic letter standing in for a relatively detailed specification of the circumstance I am in at the time)" (*ibid.*).

[23] At a certain point, there is nothing odd at all about neural states' representing themselves. After all, we *think* about our neural states. However, the issue here has to do not with cognitively representing our own neural states but with perceptually representing them.

[24] Save perhaps for recherche, and irrelevant, time travel cases—like Effingham and Robson's (2007) self-made, time-travelling brick wall—irrelevant because we should not think content-vehicles causally covary with themselves by way of time travel.

[25] I have left room for stygian color relations' potential accommodation by teleosemantic accounts that do not appeal to causal covariation, accounts like Millikan's (1984) or Papineau's (1993). On these views, a state's content, roughly, is the condition which explains why the state has the effects it does. But it rings false that stygian color relations (the very specific ones mentioned above) might explain why the vehicles of stygian color contents have the effects they do. (Which effects are these supposed to be? Subjects' self-reports?) However, the rest of the case against the naturalizability of visual representation of stygian color relations calls for fuller development elsewhere—if not just for the perhaps surprising fact that the case generalizes beyond the present example to the visual representation of all colors construed relationally.

Stygian colors would be accommodated by pluralism in the case that it is possible that a single object (or single part of an object) be simultaneously maximally dark all over and hued all over. How exactly would that work on reductionism? Here is Kalderon's suggestion (2007, p. 578). On reductionism, colors are sets/determinables of determinate reflectances.[26] Instantiating a determinate reflectance is a way of being colored—a way of falling under a determinable. For an object to be multiply colored is for its determinate reflectance to belong to distinct determinables, which determinables bear unique similarity-relations to the other color-determinables. By falling under distinct determinables, determinate reflectances "bear different similarity relations to different properties, and so participate in distinct families of properties" (*ibid.*; but see also Kalderon, 2011, Sect. 5). Applied to our case, we should say that stygian colors are possible if an object is possibly maximally dark all over and distinctly hued all over, simultaneously.

5.6 Reply

This sort of thinking does not look like it will help the proponent of RR. The same considerations which motivated taking stygian colors to be impossible on reductionism in the first place (Sect. 4.1) make intuitive that no determinate reflectance participates in the determinable with which maximal darkness is identical and the determinables with which any hues are identical. The former determinable is the set of determinate reflectances which are basically flat up against the wavelength axes of their associated graphs. The latter are the sets of determinate reflectances with marked upticks from those axes. We should not expect to find a reflectance that participates in both. These points apply mutatis mutandis to primitivism.[27]

6 Conclusion

The stygian color experiences provide a class of experiences whose members serve as counterexamples to RR. Each stygian experience type lacks a corresponding property which might feature as a constituent in the experience's associated Russellian content. Moreover, treating the experiences' contents as decomposing into constituent elements each of which is possible comes at too steep a price. Accordingly, RR assigns each of the phenomenally distinct stygian color experiences the same content, and the experiences thereby serve as counterexamples to the theory.

The problem posed by the stygian color experiences for RR can be avoided if we posit primitive representational contents, *à* la Burge (2010), and posit these contents' constitution by metaphysically impossible properties. But if we are not antecedently

[26] Note that this is contentious. The reductionist may not want to identify colors with sets of determinate reflectances but identify them instead with, say (recalling fn. 10), whatever as-yet undiscovered feature unifies the members of the set.

[27] Thanks to an anonymous reviewer for urging me to consider further what recourse the proponent of RR has to relationalism and pluralism.

attracted to the existence of metaphysical impossibilities or to primitive representational contents, then the stygian color experiences remain a problem for RR.

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