Daylight savings: What an answer to the perceptual variation problem cannot be*

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> *WHEREAS, as the "Sunshine State," Florida should be kept sunny year-round, NOW, THEREFORE, Be It Enacted by the Legislature of the State of Florida: . . .*
> *(2) If the United States Congress amends 15 U.S.C. §260a to authorize states to observe daylight saving time year-round, it is the intent of the Legislature that daylight saving time shall be the year-round standard time of the entire state and all of its political subdivisions.*
>
> *— Florida HB 1013 (2018)*

Abstract

Significant variations in the way objects appear across different viewing conditions pose a challenge to the view that they have some true, determinate color. This view would seem to require that we break the symmetry between multiple appearances in favor of a single variant. A wide range of philosophical and non-philosophical writers have held that the symmetry can be broken by appealing to daylight viewing conditions—that the appearances of objects in daylight have a stronger, and perhaps unique, claim to reveal their true colors. In this note we argue that, whatever else its merits, this appeal to daylight is not a satisfactory answer to the problem posed by perceptual variation.

Your friend just gave you a wonderful new coffee cup. Chuffed as you are with your gift, you watch the cup throughout the day, and notice that it varies significantly in respect of how it looks as a function of the varying illumination. In your office, the cup looks blue; in the hallway, it looks silver;

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in the department lounge, it takes on a tinge of green. Just what color is your new cup?

Such cases of changes in the looks of things (in respect of their colors) are ubiquitous in ecologically realistic settings, and have been common fodder in philosophical disputes about the nature of color since the pre-Socratics, through the Great Moderns, and up to the present (see, for example, Burnyeat 1979; Hardin 1988; Matthen 1999; Cohen 2009).[1] We can construe the challenge posed by such effects as symmetry problems: understanding the cup as having any single color requires a way of breaking the symmetry between its multiple appearances.[2] To know the cup's color (e.g., to report this fact about the cup) would require finding an acceptable, motivated breaker of the symmetry in appearances.[3]

One putative symmetry breaker has proved tempting to a range of writers, both philosophical and non-philosophical, who have appealed to natural daylight to determine the colors of things.[4] Granted, we'll want to restrict appeals to daylight to determining the colors of non-light emitting objects, be they opaque, translucent, or transparent.[5] But in that case, natural daylight has proved to have wide appeal. In one refreshingly direct formulation of this 'daylight maneuver,' Allen (2010) writes that,

> given the nature of natural daylight, and certain plausible assumptions about the nature of the colours it illuminates, there is indeed a non-arbitrary reason to suppose that experiences of colour in natural daylight present the real colours of objects (Allen 2010, p. 8; cf. Allen 2016, pp. 54-57).

[1] To say that there are such cases of perceptual variation with respect to color is not to say that our visual systems fail to exhibit color constancy; it is, rather, to say that color constancy in human visual systems is imperfect. For discussion of color constancy, its limitations, and the relation between constancy and (well-attested) instances of perceptual variation, see Jameson and Hurvich (1989), Hurlbert (1998), and Cohen (2012).

[2] There are ways of responding to the problem posed by perceptual variation, such as the irrealism of Hardin (1988) and Boghossian and Velleman (1989), the relationalism of Cohen (2009), or the relativism of Egan (2006) and Brogaard (2014), that deny that the cup has a single color, and therefore do not face the symmetry problem we have raised. This paper addresses, specifically, the use of the daylight manuever on behalf of those who accept that the cup has a single color, and for whom, therefore, our symmetry problem is a *prima facie* challenge.

[3] Note that, to appreciate the force of this symmetry problem, one need not assume that *all* viewing conditions are symmetric in this sense. Perhaps some illumination conditions—as it might be, illumination solely by a monochromatic laser set to 430nm—can be ruled out on principled and well-motivated grounds. The symmetry problem will nonetheless get off the ground if, as our example is intended to suggest is likely, there remain a multiplicity of viewing conditions (with psychophysically distinguishable effects) after one has carried out whatever motivated settings aside one can.

[4] In philosophy, see Averill (1992, pp. 583-584); Johnston (1992, p. 248); Hyman (2006, pp. 34-35). For more commonplace appeals to natural daylight, see Munsell Color Company (1976) and Minnaert (1993), or any of the many discussions of 'the dress' circa 2015 (a quick Google search and scroll through the comments section will reveal the widespread appeal of using the way that objects look in natural daylight to determine their true colors).

[5] Of course, one should hope for this restriction to eventually be relaxed. Sadly, we don't know of anyone who has managed to extend the daylight manuever in this way. We'll return to this issue in §2.

In this short note, we want to argue that, whatever else its merits, the daylight maneuver is not a satisfactory answer to the problem posed by perceptual variation. There are two main problems with the daylight maneuver. First, despite its considerable intuitive appeal, it is essentially unmotivated. Second, while the daylight maneuver targets one narrow aspect of color variation—variation in color appearance under different sorts of illumination—it cannot deal with a range of other well-known cases. In other words, the daylight maneuver looks to be over-fitted to a particular sort of case, leaving it in an unfavorable dialectical position vis-a-vis a range of more generally-applicable alternatives.

1 Motivating daylight

The daylight maneuver ostensibly provides an answer to our initial question about how to identify the cup's color. It does this by singling out one distinguished appearance from among the many variants as *the* one on the basis of which we know the color of the cup, thereby breaking the symmetry with which perception confronts us (but see §2). But is the answer it offers motivated? After all, there are many other symmetry-breakings one could have chosen. So why break the symmetry *this* way? Why think that this symmetry breaking is the one we should employ in answering the initial question? Without some justification, the daylight maneuver is a non-sequitur.

Below we consider several possible justifications, and argue that they are unsatisfactory.

1.1 Daylight reveals colors

One possible attempt to justify the choice of daylight as symmetry-breaker comes from the observation that daylight covers the whole visible spectrum and is roughly equal in power across it, meaning that it gives us a good idea of how an object reflects light across the entire visible spectrum. Thus, Allen (2010, pp. 9-13) reasons that daylight is maximally revealing of an object's surface reflectance profile:

> Even amongst illuminants that emit light in every part of the visible spectrum, however, natural daylight is still the gold standard because it satisfies the second condition of being (roughly speaking) *equal energy light*: its spectral power distribution is (roughly) flat across the visible spectrum (Allen 2010, p. 12; cf. Allen 2016, p. 54).

If one is sympathetic to the (controversial but popular) metaphysical view that colors are identical with spectral reflectance profiles—defined by the amount of incident light that the surface reflects at each wavelength in the visible spectrum (Churchland 2009) or with equivalence classes of such spectral reflectance profiles (Hilbert 1987; Byrne and Hilbert 1997a; Tye 2000)—then one might think that this provides the needed justification for the choice of daylight

as a symmetry breaker.[6] For, if daylight illumination best reveals surface spectral reflectance profiles, and colors are identical with surface spectral reflectance profiles, then daylight puts viewers in the best epistemic position available to apprehend by ordinary visual perception the colors of surfaces.

Unfortunately, considered as a justification of the daylight maneuver, the answer now under consideration has three significant drawbacks.

First, it's unclear why equal energy illumination should be thought more revealing of surface reflectance profiles than alternatives. Given the light striking visual receptors, one can derive an estimate of the surface reflectance profile by dividing by *any* known illuminant (with non-zero intensity across the visual range), whether its spectral power distribution is flat or not.

One might respond that daylight is nonetheless especially revealing of spectral reflectance profiles because it is easier to know whether that illumination prevails. But that's surely not true for every kind of creature: there might be visual systems capable of perceiving color but which are well-adapted to detect color in conditions of unequal spectral power and ill-adapted to detect color in conditions of equal power. Indeed, given the evolutionary pressures on human beings to track colors in settings involving mottled light, *our* perceptual systems are very plausibly of this sort. This is just the sort of evolutionary pressure that has given rise to color constancy effects. Given all this, much more will need to be said to motivate the claim that roughly equal spectral power distribution best reveals the colors.

Second, the proposed justification we're now considering is of much less help for the version of the view on which colors are identified with classes of reflectance profiles (rather than individual reflectance profiles). After all, the facts about daylight illumination cited suggest that it can reveal, at best, the particular spectral reflectance profile of the individual surface perceived. Assuming that one knows, antecedently, to which class of reflectance profiles that particular profile belongs, then of course one will be able to move from this information to the color of that surface. In general, however, one shouldn't be assumed to know this, as the individual profiles within each class can differ significantly from one another with respect to how they reflect light. What this means is that daylight alone cannot reveal the colors of objects; rather, at best, it reveals this only in conjunction with an understanding of the principles involved in grouping together reflectance profiles into the sets which constitute colors (for creatures like us).

The third problem for the justification offered is that it depends on a controversial theoretical view whose invocation is possibly question-begging. At least for many authors, the symmetry problems posed by perceptual variation arises within the context of a debate about the correct metaphysics of color. Within that dialectical context, a justification for the symmetry-breaking on offer that helps itself to a specific metaphysical account of colors looks highly problematic. After all, in a context in which we haven't yet concluded that colors

[6]For what it is worth, most theorists interested in such views have favored the equivalence class version because of the phenomenon of metamerism (i.e., the fact that spectral reflectances are individuated more finely than are colors). For discussion, see Hilbert (1987, ch. 5).

are identical to (classes of) spectral reflectance profiles, there's no reason to think of daylight illumination's virtue of effectively revealing spectral reflectance profiles as *ipso facto* providing access to objects' colors.[7]

To put the point slightly differently, if defending the claim that daylight reveals the true colors of things requires taking on the assumption that colors are identical to surface reflectance profiles, then the defense of said claim becomes far less interesting than one might have expected. For one might have hoped that learning that daylight reveals the true colors of things would actually help us to discern the correct metaphysics of color. If, instead, the argument for that claim requires our assuming a particular metaphysics of color, then the claim itself must be treated, dialectically, as a conditional one: if colors are identical to surface reflectance profiles, then daylight reveals the true colors of things. As we have noted above, we take there to be reasons to be skeptical of even this conditional claim. Even if these worries can be dealt with, however, we take this conditional claim to be far less interesting than one might have expected; it is the presumed background metaphysics which appears to be doing most of the heavy lifting.

1.2 Daylight reveals the supervenience base

Consider, then, a distinct answer to our request for justification based on the more modest thesis that, whether or not colors are *identical to* surface spectral reflectance profiles (or classes thereof), colors at least *supervene on* the latter. If this thesis were true, one might hold that the condition of daylight illumination nonetheless has a special epistemic advantage over other conditions in that it positions viewers well to learn about the assumed supervenience base of the surface colors they confront (Allen 2010, pp. 8-9, 2016, pp. 55-56).

Unfortunately, there are several reasons for dissatisfaction with this proposed motivation as well.

First, it is far from obvious that perception under daylight illumination is always sufficient to reveal the supervenience base of surface colors.[8] One problematic class of cases involves contrast colors, such as brown, olive green, navy blue, or white—colors that surfaces manifest only when perceived in

[7] To see the force of this point, it may be helpful to consider once again our initial quandary of how to identify the color of the cup, given its multiple appearances. Logical space makes room for the following answers: (i) just one of the cup's apparent colors is uniquely correct—as it might be, the cup is silver, rather than blue or white; (ii) the cup truly bears all of the colors it appears to have; (iii) the cup's color changes depending on the lighting conditions; (iv) it bears no color at all (though it appears colored). If one hasn't already settled on answer (i) rather than (ii), (iii), or (iv), then daylight's capacity to reveal objects' spectral reflectance profiles won't justify one in concluding that daylight reveals objects' colors. And, indeed, as noted in the main text, even if one accepts answer (i), this conclusion will still be unjustified without a further assumption that a surface's spectral reflectance profile is identical with (or at least correlated with) its color. This is just to say that the purported symmetry-breaking advantage of daylight we are now considering depends on assuming a view about the metaphysics of colors that is precisely under dispute in this dialectical context.

[8] Because identity entails supervenience, this concern is also applicable to the stronger version of the motivation discussed in §1.1.

spatiotemporal proximity with surrounding items, through the operation of contrast mechanisms (Hardin 1988, p. 70). Perceiving a surface that bears such a contrast color under daylight but without the requisite surround may put one in a position to apprehend the surface's spectral reflectance profile; but it won't by itself reveal the supervenience base for the contrast color, which includes the perception of numerically distinct items—and, moreover, different numerically distinct items for different cases, since each of these contrast colors involves contrast with distinct surrounds. A related concern involves colors, like midnight blue, that are only fully appreciable under multiple illumination types. Plausibly, part of what it is to be midnight blue is to appear blue in sunlight but black under most artificial lights; in this, midnight blue's reflectance profile differs from that of either blue or black. But for us to recognize this difference, we need to see the contrast between this color in different conditions; no single viewing condition will do. Exactly the same is true of the colors of dichroic or directionally reflective materials.

A second objection to the present proposal is that, once we forego the identification of colors with (classes of) surface spectral reflectances, it's no longer clear why daylight's alleged epistemic advantage (that of providing good information about the supervenience base for colors) is a reason for thinking variants produced in that condition are uniquely veridical. On the face of things, the epistemic property of providing good information about the supervenience base to creatures like us and the metaphysical property of generating perceptual variants that are veridical to the exclusion of others are distinct. Assuming these distinct properties must coincide would seem tantamount to accepting a principle of sufficient reason that we have no reason to endorse.

1.3 Daylight reveals color content

A quite different possible answer to our request for justification involves a different theoretical motivation, coming this time from psychosemantics.[9] Suppose one held a version of the view that the content of a token perceptual state is given by the subclass of causes of tokens of the same type that occurred in the environment in which perceptual systems like ours evolved (Papineau 1987; Millikan 1989; Dretske 1995; Tye 1995, 2000; Neander 2017). And suppose one additionally thought that the adaptively relevant environment for perceptual systems like ours were one illuminated largely by daylight (given the rarity of incandescent lighting in the Pleistocene). This would, if correct, give one a reason for breaking the perceptual symmetry by favoring daylight-produced variants: for, on these assumptions, daylight-produced variants are veridical representations of the stimulus color, while other variants are not. (Compare: if the only causes of HORSE tokens in the adaptively relevant environment were horses, then contemporary horse caused HORSE tokens are

[9]Though we're not aware of explicit invocations of this motivation in the literature, it seems worthy of consideration given the failure of other options—especially for those impressed by the ecological significance of daylight illumination.

veridical, while contemporary cow-on-dark-night caused HORSE tokens are not.)

Alas, this proposed answer seems unconvincing as well. For, crucially, there's no single illuminant that can be regarded as a necessary component of the adaptively relevant environment for perceptual systems like ours. Presumably, outdoor illumination in the Pleistocene environment of evolutionary adaptedness (mainly in arboreal/grassland areas in Africa and Eurasia (cf. Stiner 2002; Sterelny 2012)) varied with the time of day, the weather, available shade, and proximity to reflective surfaces (etc.), just as it does today. Consequently, considerations about the evolutionary past fail to install any single illuminant as a unique symmetry-breaker, as required by the daylight maneuver.

2 Further worries

So far we have argued that the daylight maneuver is unmotivated. But we have a number of other concerns as well. Specifically, it strikes us that even the most detailed versions of the thesis are substantially incomplete, and that considerations of theoretical unity speak against our employing the maneuver.

The first of these worries parallels arguments that have been offered elsewhere in the literature, typically in favor of one or another version of pluralism about the colors of things. Because natural daylight is not a uniform type of illumination, the mere, unsupplemented, appeal to daylight remains seriously underspecified. For example, direct midday light is slightly more powerful in relative terms around the yellow part of the visible spectrum, whereas the light on a cloudy day will be more powerful around the blue part. Likewise 'skylight', or indirect sunlight, is more powerful around the blue part of the spectrum. Additionally, there are significant overall differences in intensity between these two types of natural daylight. Predictably, the differences in the spectral power distributions of such distinct phases of natural daylight illumination can result in significant differences in the responses of visual systems to ordinary objects. But this means that the appeal to daylight, without further supplementation, fails to resolve the symmetry problem to which it was offered as a response: there will remain cases in which a single stimulus looks different to a normal observer in respect of its color as a function of variations in illumination that remain within the range of natural daylight.

Allen (2010, pp. 13-14), for one, is aware of this point, and therefore supplements his appeal to daylight with a more specific choice. Namely, he proposes that the symmetry-breaking illuminant is in fact neither direct sunlight nor skylight, but a combination of the two that, by canceling out peaks in one with troughs in the other, offers perfectly smooth and flat power across the visual spectrum (p. 16). Of course, nature doesn't provide perfectly smooth and flat illuminants, so Allen is prepared to advert to CIE illuminant standard D_{65} (a member of the 'daylight' series, representing a combination of direct sunlight and skylight, and intended to roughly correspond to average midday light in

Western and Northern Europe) as a good approximation to relative flatness in spectral power distribution in ecologically realistic cases.[10]

This precisification of the daylight maneuver helpfully advances the discussion: it answers the question 'what do you mean by daylight?' in a reasonably determinate way, rules out alternatives, and so at least makes it possible to invoke daylight as a way of breaking the symmetry between varying daylight illuminants. But once again we should ask: why (i.e., for what motivated reason) should we accept *this* precisification as a solution to our symmetry problem? Surely not because it is especially or uniquely ecologically valid. After all, and as we have already noted, naturally occurring illumination varies with time of day, location, weather, available shade, and other parameters. This explains why the CIE offers not one but a series of (otherwise much less flat) D illuminants, corresponding to different types of daylight with different correlated color temperatures (Judd et al. 1964). Spectrally flat illumination (and, to a lesser extent, the D_{65} approximation thereto) is distinctive among other natural illuminants (and their approximations in the D series) by its computational and mathematical tractability, but not by its ecological realism (certainly not everywhere and at all times). And we have already urged (§1) that the distinctive mathematical features of flat illumination, taken by themselves, do not add up to a reason to break the symmetry in its favor in cases of perceptual variation.

It would seem, then, that the problem we are now pressing remains unresolved. For we have seen that, without a more precise articulation of the notion of daylight itself, the daylight maneuver does not solve the symmetry problem it was enlisted to answer. However, as we have also seen, it is unclear just how to spell out a notion of daylight in a more precise way that rules out all psychophysically distinguishable alternatives (so that it will indeed resolve the symmetry problem) and is independently motivated rather than stipulative. As best we can tell, in fact, the more precise an articulation of the notion of daylight one offers, the more likely it is that this articulation will amount to raw stipulation.

But the troubles with the daylight maneuver don't end there. A further class of worries comes from the observation, also noted by Allen (2016, pp. 58-59, 65-66), that the daylight maneuver fails to resolve other structurally analogous symmetry problems. For example, there are interspecies symmetry problems deriving from variation in the mechanisms of color perception: because certain animals (e.g. pigeons, bees) are capable of perceiving light in the ultraviolet and infrared parts of the spectrum, their visual systems will respond to opaque objects differently than will those of ordinary human observers. Again, this instance of perceptual variation can be construed as an (interorganism) symmetry problem: we have one object and different visual representations of its color, and are in need of a principled method for breaking the symmetry one

[10]The artificiality of Allen's officially preferred illuminant, which plays such a central role in his view, sits uneasily with his characterization of his position as 'naïve.'

way rather than another (for regarding one of the representations veridical to the exclusion of others).

Similarly, there are intraorganism symmetry problems arising from many parameters of the viewing condition other than illumination: differences in the viewing angle, the viewing distance, the state of adaptation of the perceiver, what other objects seen simultaneously, grouping effects, etc. can all have profound effects on the color that an object will appear to a single perceiver (Hardin 1988; Cohen 2009). The daylight maneuver is plainly ill-suited to break the relevantly analogous symmetries arising from any of these sorts of perceptual variation.

Of course, defenders of the daylight maneuver are free to respond that these symmetry problems should be handled in some other manner (cf. Allen 2016, p. 50, 2010, pp. 3-4). Thus, for example, Allen responds to interspecies variation cases by accepting a limited degree of pluralism about the colors: he accepts that colors for pigeons will be distinct from colors for human beings (etc.), which means that, on his view, natural daylight won't actually reveal *the* true colors of a thing, but only one among many of its true colors. But, while this combination of views is coherent, it threatens to undermine further the attractions of the daylight maneuver. For, in so far as pluralism or other non-daylight-involving strategies for responding to perceptual variation succeed, it's unclear why they should not also be extended to deal with variation stemming from variation in illumination conditions as well, thereby obviating the daylight maneuver in favor of a more general solution to the problem. In other words, if another more general response proves defensible, then considerations of theoretical unity would seem to favor it over the daylight maneuver.

In all, then, the daylight maneuver looks to be both insufficient with respect to the specific symmetry problem raised by variations in illumination and clearly inapplicable to the many other symmetry problems confronting perception.

3 Conclusion

We take the above to show that, despite its considerable intuitive appeal and widespread invocation in real-world debates regarding the colors of things, a convincing case for the daylight maneuver has yet to be made. Many of the reasons for this are familiar, being the same sorts of reasons that have driven many to more pluralist positions on the metaphysics of color. But some are new and at least moderately surprising: *prima facie*, it seems almost absurd to doubt the claim that daylight puts one in a superior epistemic position with regards to seeing the colors of things. As we have been at pains to argue, however, this should hardly be taken for granted. On the contrary, even if colors are identical to surface reflectance profiles, our best epistemic position is going to be determined by the function of our perceptual system—itself responsive to

the conditions under which it evolved. As with the British monarchy, then, with color perception it may prove best not to let daylight in upon the magic.[11]

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