In a recent paper (Tye 2006), Michael Tye offers a solution to the problem of standard variation. I will argue for two claims. First, the problem of standard variation for the theory of colour and colour experience defended by Byrne and Hilbert (2003), Dretske (1995), Lycan (1996), Tye (2000) reduces to a problem about sensory representation. Thus, this is where the debate should focus. Second, no solution to this problem has yet been given.

1. The problem of standard variation is a problem about sensory representation

There are slight differences between John and Jane’s retinal apparatuses and optic nerves. In consequence, while colour chip 527 looks true blue (a blue not tinged with any other colour) to John, it looks greenish-blue to Jane (a shade of blue slightly tinged with green). Nevertheless, by ordinary standards, neither individual has defective colour vision. Individual differences in colour vision are rife. The same objects look different fine-grained colours to different perceivers, even where none of the perceivers counts as having defective colour vision. This is called standard variation (McLaughlin 2003). It has been thought to create problems with a certain form of Colour Physicalism (Hardin 1988, McLaughlin 2003, Cohen forthcoming), as well as with Intentionalism about colour experience (Block 1999, McLaughlin 2003). But what is the problem?

Standard Intentionalism about colour experience (Byrne and Hilbert 2003, Dretske 1995, Lycan 1996, Tye 2000) holds that differences in phenomenology among colour experiences are constituted by differences in what colours those colour experiences represent objects as having. On this view, John represents the chip as true blue, and Jane represents it as green-blue. Exclusion within Human Colour Space (Byrne and Tye 2006) holds that distinct minimal colours within human colour space exclude each other, where a colour is a minimal colour if there is no more specific shade of that colour within human colour space. Given these assumptions, John and Jane cannot both be having a veridical colour experience of the fine-grained colour of the chip. I grant these assumptions. Some claim that both might get it right (McLaughlin 2003, Cohen forthcoming), but this is pretheoretically counterintuitive. The question is: who gets it right?

One might reply that neither gets it right. On Colour Eliminativism (Hardin 1988, Pautz ms), objects do not have fine-grained colours, so that no one ever has veridical experiences with respect to the fine-grained colours of objects. But others (Byrne and Hilbert 2003, Dretske 1995, Lycan 1996, Tye 2000) combine Intentionalism with Colour Physicalism. They maintain that the fine-grained

---

1 Thanks to Michael Tye for helpful discussion and to Brian McLaughlin and Jonathan Cohen for detailed and very helpful written comments.
colours our experiences represent are reflectance properties: properties concerning
the proportion of incident light an objects is disposed to reflect. Call the
conjunction of Standard Intentionalism and Colour Physicalism Reflectance
Intentionalism. On this view, objects actually have fine-grained colours. So, some of
our colour experiences are veridical with respect to the fine-grained colours of
objects. For instance, Tye (2006: 5) allows that someone might have an experience
that accurately represents the determinate hue of the chip, even if we may never
identify the person. Suppose for the sake of argument that:

(1) John has a veridical experience of the fine-grained colour of the chip,
and Jane has a non-veridical experience of the fine-grained colour of the
chip. The chip is true blue, but not greenish-blue.

Now we may state the problem posed by standard variation for Reflectance
Intentionalists. Given that their situations are perfectly symmetrical, what makes it
the case that it is John who has the veridical experience, and Jane who has the
non-veridical experience? This appears arbitrary. Why is not the reverse the case?
The Reflectance Intentionalist will answer as follows. When John employs the
colour term ‘true blue’, he is referring to the fine-grained colour property his
colour experience represents the chip as having. On Reflectance Intentionalism,
that property is (unknown to John) some reflectance property, \( R \). True blue, then,
is identical with \( R \). The chip 527 has \( R \). So John gets it right. Likewise,
when Jane employs the colour term ‘greenish-blue’, she is referring to the fine-
grained colour property his colour experience represents the chip as having, which
is (unknown to Jane) some reflectance property, \( X \). Greenish-blue, then, is
identical with \( X \). Since true blue and greenish-blue exclude, it follows that \( R \)
and \( X \) exclude. The chip does not have \( X \). So Jane gets it wrong.

On Reflectance Intentionalism, then, the following is what makes (1) the case:

(2) John’s experience represents the chip as having \( R \), and Jane’s
experience represents it as having \( X \). The chip has reflectance property
\( R \), but it does not have reflectance property \( X \).

This is progress, but it does not completely answer the original question. We
cannot ask what makes it the case that the chip has reflectance property \( R \) but not
\( X \). These are among the basic physical facts of the situation. But consider the first
part of (2):

(3) John’s experience represents the chip as having \( R \), and Jane’s
experience represents it as having \( X \).

We may reasonably ask what makes this the case. Given that their situations are
perfectly symmetrical, what makes it the case that it is John who represents the
chip as having \( R \) (a reflectance property that the chip does have), and Jane who
represents the chip as having \( X \) (a reflectance property that the chip does not
have)? This appears arbitrary. Why is not the reverse the case?
The problem may be stated more precisely. Many philosophers, for instance
Dretske (1995) and Tye (2000), accept broadly input-based theories of sensory
representation. For instance, on Tye's view (2000: 136), sensory representation is a matter of causal-covariation under optimal conditions. But it difficult to see how such theories might have (3) as a consequence. Let the neural content-vehicle of John’s true blue experience be $P_7$ and let the neural content-vehicle of Jane’s green-blue experience be $P_8$. They are very similar neural states of the colour vision system (as it might be, states of the R-G and Y-B opponent channels). They recur in different individuals. Let the condition under which a visual state $S$ is tokened include (i) the details of the retina and the wiring leading from the retina to $S$ and (ii) the external lighting and other relevant external conditions. Both $P_7$ and $P_8$ are tokened in different individuals under different conditions $C_6$, $C_7$, $C_8$, $C_9$, $C_{10}$, . . . The conditions under which $P_7$ and $P_8$ are tokened differ from individual to individual and from time to time because those individuals’ innate wiring and environments differ. They even differ from time to time within an individual because an individual’s state of adaptation differs from time to time. Let us suppose that $P_7$ is tokened in John under condition $C_7$, and that $P_8$ is tokened in Jane under condition $C_8$. In these conditions, they are caused by the same reflectance property, $R_4$. In different conditions $C_6$, $C_7$, $C_8$, $C_9$, $C_{10}$, . . . and in different people, $P_7$ is caused by different reflectance properties $R_3$, $R_4$, $X_5$, $R_6$. . . Likewise, in the different conditions $C_6$, $C_7$, $C_8$, $C_9$, $C_{10}$, . . . and in different people, $P_8$ is caused by the very same range of reflectance properties $R_3$, $R_4$, $X_5$, $R_6$. . . (See Figure 1.) Further, the conditions $C_6$, $C_7$, $C_8$, $C_9$, . . . appear to be within the range of optimal or normal. So, what makes it the case that $P_7$ and $P_8$ represent (respectively) $R_4$ and $X_5$, to the exclusion the alternative candidates? What makes it the case that they have incompatible contents?

![Figure 1](image)

The problem for the Reflectance Intentionalist, then, is as follows:

The problem of fine-grained representation: Given that under different conditions $C_6$, $C_7$, $C_8$, $C_9$, . . ., $P_7$ and $P_8$ track various reflectance properties $R_3$, $R_4$, $X_5$, $R_6$, . . ., what makes it the case that $P_7$ represents $R_4$ while $P_8$ represents the incompatible reflectance property $X_5$?\(^2\)

\(^2\) Perhaps it will be said that the problem may be solved if we suppose that the content-vehicle John’s experience is $P_7C_7$ (being in $P_7$ under condition $C_7$), while the content-vehicle of Jane’s experience is $P_8C_8$ (being in $P_8$ under condition $C_8$). Since they include the relevant conditions, these states do not have variable causes. Each tracks only $R_4$. But, given an input-based theory of representation, this entails that John and Jane represent the same reflectance property (colour), which is contrary to our assumption.
Those who have discussed the problem of standard variation for Reflectance Intentionalists such as Tye (2000) and Byrne and Hilbert (2003) have not put the problem in exactly this way. But, by the argument just given, this is what the problem boils down to. Therefore, this is where the debate should focus. I believe that Reflectance Intentionalists implicitly recognize that for them the problem posed by standard variation reduces to the problem of fine-grained representation (Byrne and Tye 2006). As we shall see, the first solution Tye (2006) considers addresses exactly this problem.

The problem of fine-grained representation is a general problem for the project of naturalizing intentionality. My cow-thoughts are about cows, not cows or fake-cows. What makes this the case? But standard variation means that the problem is more serious in the case of sensory representation. When cow-thoughts are caused by fake-cows, there is some sense in which conditions are suboptimal or non-normal. By contrast, the conditions $C_6, C_7, C_8, C_9, \ldots$ seem on a par with respect to optimality and normalcy.

As Byrne and Tye (2006) note, in effect the problem of fine-grained representation is the problem for reductive theories of sensory representation developed in Pautz (2006) transferred to cases of standard variation. I will argue that no solution to the problem posed by standard variation for reductive theories of sensory representation has been given. Thus, while others have used standard variation to argue against certain theories of colour (Cohen forthcoming, Hardin 1988, McLaughlin 2003), here I use it to argue against reductive theories of sensory representation.

2. The first solution: biting the bullet

Tye begins by claiming that, when a thermometer’s states are tokened in the kind of conditions for which it was designed, ‘each height tracks a certain temperature and thereby represents that temperature’ (2006: 2). This is in accordance with Tye’s Optimal Cause Theory of representation:

---

3 I only claim that for Reflectance Intentionalists (who combine Colour Physicalism with Standard Intentionalism) the problem of standard variation reduces to the problem of fine-grained representation. Some Colour Physicalists do not accept any version Intentionalism. For instance, some Colour Physicalists identify colours (the references of colour names) with reflectance properties but accept a qualia-based theory of the phenomenal character of colour experience (Block 1999, McLaughlin 2003). On this view, the fine-grained phenomenal characters of John and Jane’s experiences are not a matter of their representing the chip as having different fine-grained colours (reflectance properties), but a matter of their having different fine-grained ‘qualia’, which might be identified with neural properties. Therefore, on this version of Colour Physicalism, the problem of fine-grained representation does not arise. The defender of this view still must say something about John and Jane. McLaughlin (2003) defends Colour Physicalism, but he combines it with a relationist or contextualist account of colour predications according to which both John and Jack might get it right. I will not be concerned with this version of Colour Physicalism here.
State $S$ represents property $F$ iff, if $S$ were tokened in optimal conditions, then it would be caused by $F$. (Tye 2000: 136)

The counterfactual nature of the theory accounts for the possibility of misrepresentation. Consider an example. Two thermometers of the same make are placed in an environment in which the temperature is $4^\circ F$. The first is operating in the conditions for which it was designed, but the second is covered with insulation. The mercury the of the first reaches height $H_7$, but owing to the insulation the mercury in the other reaches a somewhat lower height $H_6$. $H_7$ is actually tokened under optimal conditions. And under such conditions it is caused by the temperature of $4^\circ F$. So, on an Optimal Cause Theory of representation, it thereby represents $4^\circ F$. The first thermometer, then, gets it right. By contrast, $H_6$ is not tokened in optimal conditions. But, if it were tokened under such conditions (if it were tokened in a thermometer free of insulation), then it would be caused by $3^\circ F$. So, the second thermometer represents the temperature at $3^\circ F$. The second thermometer, then, gets it wrong.

The first solution to the problem of true blue which Tye considers is similar. Applied to the case of John and Jane, it goes as follows. Previously I noted that the conditions $C_6, C_7, C_8, C_9, \ldots$ are apparently on a par with respect to optimality. According to the first solution, this is not really the case. In John $P_7$ is tokened in condition $C_7$. According to the first solution, the fine-grained condition $C_7$ ‘meets the historical design specifications’ (2006: 3). It is so to speak, the factory condition. It is optimal. In the optimal condition $C_7$, $P_7$ tracks and thereby represents the reflectance property $R_4$ of the chip. The true blue, colour that John’s experience represents is identical with $R_4$, a reflectance property that the chip actually possesses. John, then, gets it right. By contrast, in Jane, $P_8$ is tokened in the slightly different condition $C_8$. In this condition, $P_8$ tracks $R_4$. But, according to the first solution, the condition $C_8$ does not meet the historical design specifications. It is not optimal. Rather $C_7$ is optimal. And, we may suppose that, if $P_8$ were tokened in $C_7$ (if it were tokened in an individual like John who meets the design specifications, it would be caused by $X_5$. (See Figure 1.) So $P_8$ represents $X_5$. The greenish-blue, colour that Jane’s experience represents is identical with $X_5$. Since the chip does not have this reflectance property, Jane gets it wrong. Thus, on the first solution, the answer to the question ‘What makes it the case that $P_7$ represents $R_4$, and $P_8$ represents $X_5$?’ is as follows:

First Solution If $P_7$ is tokened in the optimal condition $C_7$, it is caused by $R_4$. If $P_8$ is tokened in the optimal condition $C_7$, it is caused by $X_5$.

On the first solution, then, the asymmetry in the representational facts of the case may be traced to an asymmetry in optimality facts. Now Tye would add that we will never know the optimality facts. So we will never know that John gets it right and Jane gets it wrong. But, he says, there is a clear-cut fact of the matter concerning who gets it right (2006: 3).

But the question arises: given that the conditions $C_6, C_7, C_8, C_9, \ldots$ appear on a par, what makes John’s condition $C_7$ the optimal condition, and Jane’s condition $C_8$ and all other conditions non-optimal? For instance, why is not $C_8$ optimal and
C, non-optimal? Then Jane would be the one who gets it right, and John would be the one who gets it wrong.

One might reply that C₈ is non-optimal because, when Jane views the chip in C₈, she has a colour experience which inaccurately represents the R₄ chip as having reflectance property X₅. By contrast, when John views the chip in C₇, he accurately represents the chip as having R₄. (Byrne and Tye (2006) apply this move to a different case.) But this is circular. The Optimal Cause Theory explains representation in terms of causal-covariation under optimal conditions. It is meant to show how to construct the representational facts of a situation out of the non-representational facts. Therefore the defender of this theory cannot explain optimal conditions in terms of the alleged representational facts of a situation – the very facts an explanation of which is sought. To avoid circularity, optimality must be explained in terms of notions such as normality, fitness, evolutionary history, and so on (Chalmers 2006, Pautz 2006, note 5). But, in all of these respects, C₇ and C₈ appear on a par.

In the thermometer case, it is obvious what makes the insulated condition non-optimal: it is not the condition which prevailed when the thermometer came from the factory. It literally does not meet the design specifications. Likewise, one might claim that, for some reason, it was important to the survival of our ancestors that they view objects in condition C₇, the condition under which John views the chip. Having this very specific visual apparatus, and viewing objects under certain these very specific lighting conditions, somehow increased adaptive fitness. For instance, it was important that we view objects under C₇, because it was important that P₇ and not P₈ track R₄. In consequence, there was a kind of Eden period in which the majority of our ancestors viewed objects in condition C₇. C₇ meets the design specifications; is the factory condition. This is what makes it the optimal condition. Later, through genetic abnormalities, our visual states came to be tokened in conditions other than C₇, conditions in which they were not designed to be tokened. The condition C₈, the condition under which Jane views the chip, is such a condition. This is what makes it non-optimal.

But now that this story has been made explicit we see that it is not plausible. Tye appears to agree. He writes, ‘surely there is no one specific determinate background and no one specific determinate set of lighting conditions against which colour vision evolved.’ Thus, to suppose that Mother Nature picked one condition as the optimal condition ‘seems far-fetched’ (2006: 4). (See also Cohen forthcoming.) In respect of optimality, the conditions C₆, C₇, C₈, C₉, . . . are on a par. This is the Symmetry Thesis of Pautz (2006) transferred to cases of standard variation. Tye, then, rejects the first solution for good reason. This bullet, he says, cannot be swallowed.

3. The second solution: is it really a solution?

Tye goes on to provide what he calls ‘an alternative solution’ to the problem of true blue. I believe that what Tye says is correct. But, unlike the first solution he considers, it does not address the problem of fine-grained representation. Yet this is the crux of the problem. Here is what Tye says:
As she considered our distant ancestors, [Mother Nature] noted that among them, those who were sensitive to the coarse-grained colours of things were better able to re-identify them in a variety of settings and thereby engage in behaviour that increased their chances of survival. However, she did not note any adaptive benefits associated with the discrimination of determinate shades of colour among these creatures (or so it seems plausible to suppose). (Tye 2006: 4)

Thus, ‘neither of our two perceivers was designed to get the determinate hues just right’. To illustrate the point, consider the reflectance property $R_4$. The following claim is plausible:

Indifference: Selection pressures are indifferent as to which of the states $P_6$, $P_7$, $P_8$ . . . tracks $R_4$. Mother Nature does not care.

Of course, selection pressures are not completely indifferent as to what brain state tracks a given stimulus. For instance, maybe they determine that some or other highly distinctive, orange-representing brain state tracks oranges, so that we can easily pick out oranges from the background. What Indifference says is that they do not determine exactly what orange-representing state tracks oranges.

Given Reflectance Intentionalism, it follows from Indifference that we were not designed to get the determinate reflectance property of $R_4$ objects just right. For, on Reflectance Intentionalism, $P_6$, $P_7$, $P_8$ . . . represent different reflectance properties $R_3$, $R_4$, $X_5$, $R_6$, many of them incompatible with $R_4$. In John, by chance, brain state $P_7$ is caused by the reflectance property $R_4$. On Reflectance Intentionalism, $P_7$ represents $R_4$. So, by accident, John gets the determinate hue of the chip just right. In Jane, by contrast, brain state $P_8$ is caused by the reflectance property $R_5$ of the chip. But, on Reflectance Intentionalism, $P_8$ represents $X_5$. So she gets the determinate hue of the chip wrong. Tye offers a helpful analogy: if the precise time is not important to us, we might use a clock that rounds up. Sometimes, by accident, we get the fine-grained time right. But we often get it wrong.

It seems that the Reflectance Intentionalist should accept Indifference, but does it provide answer our question about fine-grained sensory representation? It does not. It only answers the following historical/cause question:

What is the historical/cause explanation of the fact that some individuals represent the reflectance properties of objects accurately, while others do not?

Given Reflectance Intentionalism, Indifference is the correct answer to this question. But Indifference does not answer the original constitutive question:

What makes it the case that some individuals represent the reflectance properties of objects accurately, while others do not? Given that under different conditions $C_6$, $C_7$, $C_9$, $C_9$ . . ., $P_7$ and $P_8$ track various reflectance properties $R_3$, $R_4$, $X_5$, $R_6$, what makes it the case that $P_7$ represents $R_4$ while $P_8$ represents the incompatible reflectance property?
so that as they view the $R_4$ chip John gets it right while Jane gets it wrong?

On Reflectance Intentionalism, $P_7$ represents $R_4$ and $P_8$ represents a similar, but incompatible property $X_5$. Indifference only says that Mother Nature does not care which of these brain states tracks $R_4$ in any particular case, and so does not care whether we get the reflectance property (on Reflectance Intentionalism, colour-property) of the chip exactly right. It does not say what makes it the case $P_7$ represents $R_4$, while $P_8$ represents a similar, but incompatible property $X_5$.

In fact, Indifference seems to make the problem worse. On Fred Dretske's (1995) theory of content,

\[
\text{State } P \text{ represents property } F \text{ iff } P \text{ has the indicator function of indicating } F.
\]

One might hope that Dretske's theory can be used to solve the problem of fine-grained sensory representation. But, given Indifference, this is not the case. One cannot say that $P_7$ represents $R_4$ because $P_7$ has the implied indicator function of indicating $R_4$, or that $P_8$ represents $X_5$ because $P_8$ has the implied indicator function of indicating $X_5$. Given Indifference, if $P_7$ tracks $R_4$ or $P_8$ tracks $X_5$, this a result of chance, not design.

I conclude that what Tye says is plausible, but that it does not answer crux of the problem. Evidently, John and Jane's colour experiences represent the chip as having the incompatible fine-grained colours blue$_4$ and greenish-blue$_5$. On Reflectance Intentionalism, these colours are identical with incompatible reflectance properties, which I have dubbed 'R$_4$' and 'X$_5$'. But, given that $P_7$ and $P_8$ are caused by the same range of reflectance properties under various conditions, what makes this the case? The first solution addresses this constitutive question. But it is not correct. By contrast, the second solution fails to address this question, and only address the distinct causal/explanatory question.

4. A Third Solution?

In a final foot-note, Tye turns back to his Optimal Cause Theory of representation. He says that 'optimal conditions for perceptual experiences of fine-grained hues are naturally taken to require that the perceiver's visual system be operating as it was designed to operate with respect to the detection of such hues.' But John's colour detection system was designed to detect coarse-grained colours (reflectance properties), not fine-grained colours (reflectance properties). This follows from Indifference. Tye concludes that 'it is not true . . . that John, as he views . . . chip 527, is in optimal conditions for the perception of fine-grained hues.' Let us say that the condition in which a state is tokened is optimal, iff it is optimal for the perception of fine-grained hues. Note that if this reasoning is correct, then no condition is actually optimal, for although (on Reflectance Intentionalism) our experiences represent fine-grained reflectance properties, none of us has a visual system which was designed to detect fine-grained reflectance properties. (By 'fine-grained reflectance properties' I mean reflectance properties
which the Reflectance Intentionalist would identify with fine-grained colours.) So, in the actual world, none of the conditions $C_6$, $C_7$, $C_8$, $C_9$, ... is optimal.

But, given the Optimal Cause Theory, merely pointing this out is not yet to answer the question ‘What makes it the case that $P_7$ represents the reflectance property $R_4$ while $P_8$ represents the incompatible reflectance property $X_5$?’ Consider again the thermometer example from §2. To point out that, in the second thermometer, $H_6$ is tokened in a non-optimal condition (because of the insulation), is not yet to answer the question, ‘What makes it the case that $H_6$ represents the temperature at 3°F, even though the actual temperature is 4°F?’

Given the Optimal Cause Theory, one must say what it would take for conditions to be optimal, and make it plausible that, if $H_6$ were tokened in such a condition (without insulation), then it would be caused by the temperature of 3°F. Similarly for the case of John and Jane. $P_7$ is tokened in John under condition $C_7$, and $P_8$ is tokened in Jane under condition $C_8$. Tye claims that neither $C_7$ nor $C_8$ is optimal. But that does not answer the question, ‘What makes it the case that $P_7$ represents the temperature at 3°F?’ The Optimal Cause Theorist must say what it would take for a condition to be optimal, and make it plausible that, if $P_7$ and $P_8$ were tokened under such a condition, then they would be caused by $R_4$ and $X_5$, respectively.

But one might wonder: what would it take for a condition to be optimal? According to Tye, no condition is actually optimal, because our colour vision system was not designed to track fine-grained reflectance properties. Tye (in discussion) suggested that, in a world in which we are designed to track fine-grained reflectance properties, some conditions are optimal. For instance, in the actual world, $C_7$ is not optimal, because in the actual world no condition is optimal. As Tye says, to suppose that Mother Nature picked one condition as the optimal condition ‘seems far-fetched’ (2006: 4). As we have seen, this is why the first solution fails. But, in some world $W_7$, $C_7$ is optimal. In $W_7$, Mother Nature picked this one condition as the optimal condition. In $W_7$, by contrast to the actual world, it was for some reason important to the survival of our ancestors that they view objects in condition $C_7$. For instance, it was important that they view objects under $C_7$, because it was important that $P_7$ and not $P_8$ track $R_4$. In consequence, in $W_7$, the majority of human beings view objects in condition $C_7$. Those who do not are deviant. It is difficult to imagine why this should be, but presumably there is such a world. In $W_7$, when $P_7$ and $P_8$ are tokened in the optimal condition $C_7$, $P_7$ is caused by $R_4$ and $P_8$ is caused by $X_5$.

One might think that this means that the Optimal Cause Theorist can answer the question ‘Given their variable causes, what makes it the case that in the actual world $P_7$ represents $R_4$ while $P_8$ represents $X_5$?’ as follows:

**Third Solution** If $P_7$ were tokened in an optimal condition (as in $W_7$), then $P_7$ would be caused by $R_4$. If $P_8$ were tokened in an optimal condition (as in $W_7$), then $P_8$ would be caused by $X_5$.

Given the Optimal Cause Theory, these counterfactuals provide the necessary and sufficient conditions for the corresponding representational claims. But these counterfactuals are false, or indeterminate. The problem is that in different worlds
Mother Nature selects different conditions as the optimal condition. True, in one world, \( W_7 \), Mother Nature selects \( C_7 \) as the optimal condition. In \( W_7 \), when \( P_7 \) and \( P_8 \) are tokened in the optimal condition, \( P_7 \) is caused by \( R_4 \) and \( P_8 \) is caused by \( X_5 \). But, in another world \( W_9 \), Mother Nature selects a different condition, \( C_9 \), as the optimal condition. In \( W_9 \), when \( P_7 \) and \( P_8 \) are tokened in the optimal condition, they are caused by some other reflectance properties. In general, in different worlds \( W_6, W_7, W_8, W_9, \ldots \), Mother Nature selects different conditions \( C_6, C_7, C_8, C_9, \ldots \) as the optimal conditions. And, in those different conditions, \( P_7 \) and \( P_8 \) are caused by different reflectance properties \( R_3, R_4, X_5, R_6 \). Furthermore, they are equally nearby worlds. It follows that it is not true that, if conditions were optimal, then \( P_7 \) would be caused by \( R_4 \) and \( P_8 \) would be caused by \( X_5 \). This counterfactual is false, or indeterminate. Consider an analogy. A jar is filled with lottery tickets. Consider the claim that, if you were to draw two tickets, you would pick ticket 444 and ticket 555. It is false, or indeterminate. Pending further clarification, I conclude that the Optimal Cause Theory is incompatible with the claim that, in the actual world, \( P_7 \) and \( P_8 \) represent the incompatible reflectance properties \( R_4 \) and \( X_5 \).

So far I have only considered Tye and Dretske's theories of sensory representation. But it is very hard to see how any reductive theory of sensory representation might deliver the verdict that \( P_7 \) and \( P_8 \) represent incompatible reflectance properties. To appreciate the problem, consider yet another analogy, one which (unlike the thermometer analogy from §1) is genuinely analogous to the case of John and Jane. Someone creates many mechanical (for instance, thermoelectric) thermometers. Each thermometer has a needle which goes up and down depending on the temperature. But he did not care about knowing fine-grained temperatures. So our designer did not put numbers on the thermometers. More importantly, he did not make all the thermometers the same. By some chance process, the machinery of the thermometers varies from thermometer to thermometer. In fact, by chance, the response of a single thermometer varies through time (just as the wiring of a single person changes through time depending on her state of adaptation and other factors). Two of these thermometers are placed in the same environment. The needle of the one reaches a point which is 4.7 inches from the base, while the needle of the other reaches a point which is 4.8 inches from the base. As a result, they have different `experiences'. Do the states of dimming 4.7 inches and dimming 4.8 inches represent incompatible temperatures within this community of temperature-detectors? This would be so if dimming 4.7 inches and dimming 4.8 inches somehow represented incompatible, fine-grained temperatures \( T_4 \) and \( X_5 \). But there is no reductive theory of derived intentionality which delivers this result. Instead, these needle states both represent that the temperature is around so-and-so. John and Jane are like these variable thermometers. And it is equally difficult to see how any reductive theory of original intentionality might deliver the verdict that \( P_7 \) and \( P_8 \) represent incompatible reflectance properties. Rather, such theories would seem to deliver the verdict that the represent that the reflectance property of the chip is roughly so-and-so. But the Reflectance Intentionalist needs the verdict that they represent incompatible reflectance properties for intuitively John and Jane represent incompatible colours. To solve the problem, the Optimal Cause Theorist cannot
appeal to counterfactuals about what fine-grained reflectance properties these states would track, were we designed to reliably track fine-grained reflectance properties such counterfactuals are false or indeterminate.4

I draw two conclusions. First, the problem posed by standard variation for Reflectance Intentionalists (Byrne and Hilbert 2003, Dretske 1995, Lycan 1996, Tye 2000) reduces to the problem of fine-grained representation. Second, no solution to this problem has been given. The first solution does not succeed, the second solution does not address the problem, and the third solution does not succeed.

It should be noted that the problem fine-grained representation is not only a problem for Reflectance Intentionalism. It is a problem for any version Intentionalism. Consider, for instance, a version of Intentionalism which holds that the colour properties (or colour-like properties) true blue_4 and greenish-blue_5 are primitive properties, rather than reflectance properties. The defender of such a view faces the question: what makes it the case that John's experience represents true blue_4, while Jane's experience represents greenish-blue_5?

One might think that the proper moral of the difficulty in finding a reductive theory of sensory representation which provides an answer to this question is not that there is no such correct reductive theory, but only that 'sensory representation is a very difficult subject' (Byrne and Tye 2006). But, in my view, the fact that we cannot even come close to formulating such a theory makes it reasonable to conclude that the project of naturalizing sensory intentionality fails. There is no explanation of the fact that John's experience represents true blue_4 and Jane's experience represents greenish-blue_5 that takes the form of a deduction from some reductive theory of sensory representation. Given that this is a general problem for Intentionalists, one might wonder how it bears on Colour Physicalism. The answer is that it bears on Colour Physicalism indirectly. For if we Intentionalists must give up on the reduction of sensory representation, what is the argument for

---

4 It is worth mentioning two solutions to the problem of fine-grained for the Reflectance Intentionalist which I have not considered. (i) So far, I have considered input-oriented theories of sensory representation, such as those defended by Tye and Dretske. On David Lewis's output-oriented theory, the right assignment of contents is 'the one that does best at assigning contents that rationalize behavior, according to the principles of common sense psychology' (1983: note 2). But I do not see how this theory might offer a solution to the problem. (Lewis himself is not an Intentionalist and so does not face the problem.) Granted, P_7 and P_8 dispose John and Jane to engage in slightly different fine-grained classificatory behaviors. But, on this type of theory, what makes the assignment of R_4 to P_7 and X_5 to P_8 the right assignment, rather than the reverse assignment of X_5 to P_7 and R_4 to P_8? Both assignments rationalize the colour-related behaviors of John and Jane equally well (or unwell). (ii) Perhaps it will be said that the Reflectance Intentionalist can solve the problem of fine-grained representation by combining an input-based theory with the claim that P_7 and P_8 represent indeterminate contents, or perhaps the claim that it is indeterminate what contents they represent. But I do not believe that this claim would solve the problem. For, since P_7 and P_8 are caused by the same range of reflectance properties R_9, R_9, X_5, R_6, ..., any such theory would seem to entail that they represent that the reflectance of chip is roughly so-and-so, just as the variable thermometers represent that the temperature is roughly so-and-so. But, again, this goes against Tye's claim, which is intuitively correct, that John and Jane cannot both get it right.
insisting on the reduction of the colours which our experiences represent to reflectance properties?

References
Pautz, Adam. ms. Color Eliminativism.
http://www.nottingham.ac.uk/journals/analysis/preprints/preprintlist.html