THE SENSORY CONTENT OF PERCEPTUAL EXPERIENCE

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Abstract: According to a traditional view, perceptual experiences are composites of distinct (but related) sensory and cognitive components. This dual-component theory has many benefits; in particular, it purports to offer a way forward in the debate over what kinds of properties perceptual experiences represent. On this kind of view, the issue reduces to the questions of what the sensory and cognitive components respectively represent. Here, I focus on the former topic. I propose a theory of the contents of the sensory aspects of perceptual experience that provides clear criteria for identifying what kinds of properties they represent.

1. Introduction

Although many in the contemporary philosophy of perception assume that perceptual experiences are unified states akin to cognitive states such as beliefs or desires (e.g., McDowell 1994; Dretske 1995; Tye 1995; Siegel 2010; Mandik 2012), a traditional view holds that perceptual experiences are composed of distinct (though highly related) *sensory* and *cognitive components* (e.g., Kant 1787/1998; Sellars 1956/1997; Rosenthal 2005; Lyons 2009; Bengson et al 2011; Reiland 2014). Thomas Reid (1764/1997), for example, held that the visual experience of a tree consists in *perceptual sensations* corresponding to the tree's various sensible properties such as its color and shape as well as an occurrent *perceptual belief* about what one senses—that is, a thought to the effect that there is a tree standing before one. Following A. D. Smith (2002, p. 67), I'll call such views versions of the 'dual-component theory' ('DCT') of experience.

Because many presuppose unified views of perception, there has been much recent debate about what sorts of properties perceptual experiences represent.[1] While some maintain that experiences represent only *low-level properties* such as colors, shapes, odors, and tastes (e.g., Hume 1739/2000; Tye 1995), recently others—prominently Susanna Siegel (2006, 2010)—have argued that experiences represent *high-level properties* such as kind properties (e.g., the property of being a tree) or causal relations (for review, see the essays in Hawley and Macpherson 2011). On the latter view, we can visually represent trees as trees; on the former, the property of being a tree is not represented in visual experience but in downstream nonperceptual states such as belief. Tim Bayne (2009, pp. 385-386) dubs proponents of the view that experience represents only low-level properties 'conservatives' and those who think experience also represents high-level properties 'liberals'. We can call the question of what kinds of properties are represented in perceptual experience 'the Perceptual-Content Question'.

The DCT is attractive for several reasons; one of its advantages is that it offers a way forward in the debate over the Perceptual-Content Question. If a version of it is correct, then the issue reduces to the questions of what the components of experience represent. And depending on how the cognitive components of experience are construed, as Siegel (2010, p. 22) observes, the Perceptual-Content Question may be rendered comparatively uninteresting. If the cognitive components prove to be a variety of belief as Reid held, then, insofar as there are arguably no limits to what beliefs can represent, the DCT is consistent with the liberal position that perceptual experiences can and do represent high-level properties (see Quilty-Dunn ms.).

On some versions of the DCT, the sensory aspects are nonrepresentational—Reid, for example, held they were mere 'raw' feelings—and so the issue ends there. But many promising versions of the view hold that both components are representational, though in different ways (e.g., Sellars 1956/1997; Rosenthal 2005; Coates 2007). That is, while the cognitive dimensions have *conceptual content*, the sensory components have *nonconceptual content*—however that distinction might be drawn (for discussion, see Byrne 2005). Thus we must ask: what kinds of properties do such sensory components represent? Call this 'the Sensory-Content Question'.[2] If we are drawn to the DCT, this question is fundamental to answering the Perceptual-Content Question and central to the development of any version of the view. This question, however, seems to have been largely neglected. Perhaps this is because many assume that the sensory components represent low-level properties only. But it is not obvious that this is the case—and even if it were, proponents of the DCT require a principled reason for holding this view.[3]

In this paper, I propose a novel approach to answering the Sensory-Content Question. Although perhaps the most widely endorsed approach to settling the Perceptual-Content Question is what Siegel has called the 'method of phenomenal contrast' (e.g., Siegel 2006; Bayne 2009), this method has recently been criticized (see, e.g., Bayne and Montague 2011, pp. 22-23; Nanay 2012, p. 237; Quilty-Dunn ms.).[4] Instead, I sketch a theory of the contents of the sensory components, an account that provides clear criteria for determining what kinds of properties those components can represent.[5] I do not defend the DCT *per se* (for some objections, see Smith 2002, pp. 67-93; for some advantages and responses to objections, see

Coates 2007), nor do I take a stand on the nature of the cognitive components.[6] But if we are drawn to a DCT, and if we have independent reason to think that perceptual experiences represent properties that this theory of sensory content reveals cannot be sensorily represented, then we can conclude that such properties are represented by nonsensory components of experience.

I begin in section 2 by explaining why a theory of mental content might be a good place to seek an answer to the Sensory-Content Question. Then, in section 3, I sketch a promising theory of sensory content. In section 4, I argue that this theory provides a means to determine what the sensory components of experience represent. I close by considering objections to this proposal in section 5.

2. Theories of Content and the Content-Questions

A theory of mental content seeks to explain why particular mental items are about or represent certain things—why, for example, the thought that it's raining is about (something like) the fact that it's raining or why the concept PINE TREE represents (something like) the property of being a pine tree (for a review of some classic theories of content, see the essays in Stich and Warfield 1994). A theory of the sensory components of experience would explain why it is that the sensory component of a perceptual experience represents the color red as opposed to green, another property altogether, or nothing at all.

It would seem natural to look to such theories to answer either of the Content Questions. An explanation of why it is that (the components of) perceptual experiences represent what they do would doubtless have implications for what kinds of properties such states can represent. Indeed, proceeding otherwise seems to put the cart before the horse, since it is not obvious that any theory of the contents of perceptual experience can explain how a property is represented. Suppose an alternative method for answering the Perceptual-Content Question such as the method of phenomenal contrast were to deliver the result that X's are represented in experience—for us just to discover that our theory of perceptual content cannot explain how X's are perceptually represented. What to do then?

Of course, if a version of the DCT is true, then it does not make sense to speak of *the* theory of the contents of perceptual experience. If perceptual experiences are constituted by distinct sensory and cognitive components, then there is no good reason to assume that whatever theory of content applies to the sensory components must apply to the cognitive ones. Moreover, if (as I argue shortly) the sensory components are nonconceptual, then it is hardly clear that the theory of their contents would be in any way akin to the theory that explains the conceptual contents of cognitive states (cf. Cutter and Tye 2011, p. 106, fn. 3). On unified views of experience according to which perceptual content is wholly conceptual (e.g., McDowell 1994; Mandik 2012)—that is, theories in which perception and cognition have the same kind of content—this approach to answering the Perceptual-Content Question cannot work. But since the theory of sensory content that I will present shows that the sensory components of experience are quite unlike cognitive states, these views are at best questionable.

There are, of course, several accounts of the contents of perceptual experiences available. To date, most who assume unified theories of perceptual experience defend varieties of so-called *tracking theories* of perceptual content (e.g., Dretske 1995; Tye 1995; Stalnaker 2003). Although their details vary, such views hold that a perceptual experience represents something just in case it stands in the appropriate tracking relation to it; candidates include *carrying information about* or *causally co-varying under optimal conditions with* it.[7] Here, for example, is Michael Tye's well-known version of this kind of account: 'For each [perceptual] state S of object x, within the relevant set of alternative states of x: S represents that P = If optimal conditions obtain, S would be tokened in x if and only if and because P' (1995, p. 101).

Such theories are attractive in part insofar as they purport to *naturalize* perceptual representation (cf. Neander 2006). Proponents of these views maintain that the relevant content-determining relations can be characterized in purely physical, nonrepresentational terms. Likewise, they typically argue that the sensible properties of objects—such as colors, odors, or flavors—can be characterized in nonmental, physical terms. The colors, for example, are often identified with (sets of) *surface spectral-reflectance properties* ('SSRs') (e.g., Dretske 1995; Tye 1995). Thus it would seem that perceptual representation can be explained wholly naturalistically. Moreover, proponents of such a view might avail themselves of the following method for answering the Perceptual-Content Question: take a perceptual experience S, determine which properties cause S to token under optimal conditions, and conclude that this state represents those properties. If we can find a state that represents high-level properties using this method, it would seem that the problem is solved.

Recently, however, some have argued that such tracking theories are problematic; rather than rejecting the view that perceptual experience is representational, they have concluded that perceptual representation is instead *primitive* and so resists naturalistic reduction (e.g., Chalmers 2006; Pautz 2006). But primitivism is explanatorily unappealing and giving up the goal of naturalizing perceptual content is unnecessary.

In the next section, I argue that the DCT fits nicely with an alternative naturalistic theory of sensory content. Moreover, I'll argue that this theory provides a clear method for answering the Sensory-Content Question. While this view is quite promising, I won't defend it here *as such*. Rather, I put forward the following conditional: *if* we accept this theory, then we can answer the Sensory-Content Question. Arguably, however, the theory's ability to resolve this issue constitutes independent motivation for the view.

3. A Sketch of a Theory of Sensory Content

Tracking theories of mental content are *atomistic* theories insofar as they hold that a state's content does not depend on that state's relationships to other states; rather, a state's content depends only on its appropriate *one-to-one* connection to the thing it represents.

But atomistic theories are not the only theories of perceptual content. Recently, several philosophers have been converging on the idea that the sensory aspects of perception can be understood in a *holistic* way—that is, in terms of experiences' relationships to one another (e.g., Sellars 1956/1997; Shoemaker 1975; Clark 1993; Churchland 2007). Here I focus on David Rosenthal's (1991, 2005, 2010) version of this view, which he calls 'quality-space theory', as I believe that it is the most developed version of it. Rosenthal defends a version of the DCT wherein perceptual experiences have both conceptual content and sensory features that he calls 'mental qualities'. Though Rosenthal explicitly casts his theory as an account of the *qualitative character* of perception, his view can be read as yielding an account on which sensory content is individuated holistically.

Quality-space theory pursues an approach fundamental to cognitive science—a particular set of observable behavioral data form a body of evidence supporting an account of the inner psychological processes that underwrite those behaviors. Here the behaviors in question are a creature's sensory discriminatory behaviors. What makes the view holistic is that these behaviors generate *families* of sensible properties standing in similarity-and-difference relations to one another; the inner sensory components that the theory posits are thus also construed as falling into families, which in turn holistically individuate their contents.

What are these sensory discriminatory behaviors? Common sense holds that each sensory modality—such as vision, smell, or taste—enables us to distinguish among circumscribed sets of properties. Vision, for example, enables us to discriminate the colors from one another. And these discriminatory behaviors can be measured experimentally. For example, by presenting participants with successive pairs of stimuli (e.g., pairs of color chips), one can test whether there are so-called *just noticeable differences* between them; alternatively, one can simply examine whether or not a creature is able to distinguish two stimuli (see, e.g., Rosenthal 2005, p. 201, fn. 56). Rosenthal is clear that the view assumes here a suitably operationalized *behavioral* characterization of discrimination, a notion that can be explicated in purely physical, nonmental terms. In any case, the theory is neutral about precisely how to operationalize it—that is a task for experimental psychology.

It is well established that psychophysics can chart this data regarding what creatures can sensorily discriminate into what are known as *quality spaces* (see, e.g., Quine 1969; Kuehni 2010). Quality spaces are maps of comparisons. A quality space reflects the sensed similarities and differences between properties within a given family of sensible properties that a creature can distinguish via a sensory modality. So, for example, since red is discriminated via vision to be more similar to orange than it is to green, the quality space of colors discriminated by vision captures this by locating red closer to orange than to green. Likewise, since lemons are discriminated via smell to be more like limes than like chocolate, the odor of lemons will be located closer to the odor of limes than to the odor of chocolate in the quality space of odors. Such spaces are thus representations of creatures' sensory discriminatory *capacities*—that is, creatures' abilities or dispositions to discriminate sensible properties. And these are potentially multidimensional spaces. The quality space of colors, for example, is typically thought to be ordered along the three dimensions of hue, saturation, and brightness (e.g., Hardin 1993, p. 26).

To be clear, these dimensions are not the dimensions of the colors that, for example, metaphysicians of color or color scientists might posit. Rather, they are the dimensions that perceptual psychologists identify in order to classify how the colors vary *as they are discriminated via sensory modalities*. While color metaphysicians may observe that the colors vary in terms of, for example, their physical SSRs, such properties need not—and indeed do not—make up the relevant kind of dimension of colors because they are not properties that distinguish colors as they are discriminated via vision. For example, if a creature cannot visually distinguish an SSR, P1, from an SSR, P2, then P1 and P2 will be located at the same location in that creature's color space. Thus, as Rosenthal (2005, pp. 168-169) proposes, we can think of each discriminated color as the *equivalence class* of all SSRs located at each particular location.

The central insight of Rosenthal's theory is that, in order for creatures to be able to engage in the kind of distinctive discriminatory behaviors that are represented by their quality spaces, they must be able to be in psychological states that vary in ways that mirror the ways in which the sensible properties in a given quality space relate to one another. That is, since perceptual experiences enable creatures to sensorily discriminate among sensible properties, there must be spaces of aspects of those states (in virtue of which they can make these discriminations) that are extrapolated from and match their corresponding quality spaces of sensible properties. Rosenthal writes,

> The differences among the states in virtue of which the creature can perform these discriminations must reflect the differences among [sensible] properties that the creature can discern. So the quality space that reflects the [sensible] properties a creature can discriminate by a particular sense modality will also determine the perceptual states that make such discriminations possible. And if mental qualities play a role in perceiving, it's natural to identify them with the properties in virtue of which perceptual states differ. The quality space that captures the similarities and differences among the perceptible properties a creature can discriminate will also describe the mental qualities that figure in such discrimination. And this gives us an account of mental qualities in terms of the quality space that describes a creature's ability to discriminate (2010, p. 377; cf. Sellars 1956/1997, p. 112).

On this view, just as the quality space of the colors reveals that red is closer to orange than it is to green, there must be a matching space of the sensory components of color experiences, in which the sensory component of an experience of red is closer to the sensory component of an experience of orange than it is to the sensory component of an experience of green.

Such (spaces of) sensory components are cognitive-scientific posits proposed to explain creatures' (dispositions to engage in) sensory discriminatory behavior regarding families of sensible properties. Without such sensory components, it is unclear how creatures could distinguish stimuli using their sense modalities and intelligently interact with their environments. The capacities to token such components, captured by the relevant spaces, are thus at least partially innate, although they arguably can be adjusted by learning or other processes (cf. Quine 1969, p. 123).[8]

Although Rosenthal casts his theory as an account of qualitative character, perhaps the most reasonable explanation of how the sensory components of experience enable such discriminatory behaviors is that they *represent* their corresponding sensible properties. And Rosenthal is clear that mental qualities are representational (e.g., 2005, p. 208). It is thus natural to read the view as holding that these spaces holistically individuate the contents of perceptual experiences' sensory components.[9] Adapting the name of Rosenthal's theory, we can dub this account of sensory content 'quality-space semantics' ('QSS'):

> **Quality-Space Semantics**: The sensory component S of a perceptual experience E represents a sensible property P of type T iff S occupies a location within the space of sensory components of experiences of T-type sensible properties that corresponds to the location of P within the space of T-type sensible properties.

Suppose that I see a pine tree with green leaves. On the version of the DCT that I am sketching, the cognitive dimension of this experience, however it is understood, conceptually represents (something like) the fact that there is a pine tree. But I also have various sensory representations of the tree's sensible properties such as the greenness of its leaves. According to QSS, the sensory dimension of my experience represents green, and not red or orange, because it occupies a location within the space of sensory components of experiences of color that corresponds to the relative location occupied by green within the matching quality space of colors.[10] And QSS holds that perceptual experience's sensory aspect is accurate only if the property to which it corresponds is present and inaccurate otherwise.[11]

QSS thereby amounts to a species of an *isomorphism-based account* of mental content (for defense of different, though classic, isomorphism-based account, see, e.g., Millikan 1984, p. 107; cf. Shea 2014). QSS holds that there is a one-to-one (or isomorphic) mapping of sensory components to sensible properties—and it is because of this isomorphism that the former represent the latter.[12] Such isomorphisms are not arbitrary: they hold because the spaces of sensory components are simply extrapolated from their corresponding spaces of sensible properties, themselves generated by creatures' sensory discriminatory behavior regarding those properties, to explain those behaviors.

Importantly, QSS holds that what identifies and individuates an experience's sensory content is not that its sensory component stands in an atomistic relationship with a property—for example, that the component causally covaries with the property. According to QSS, sensory discrimination is understood holistically, in terms of creatures' capacities to draw distinctions between sensible properties within particular families, captured by their respective quality spaces. QSS is thereby a holistic theory insofar as an experience's sensory content is identified and individuated not by its individual connection to a property, but by the sensory component's unique location in a space of sensory components relative to all other sensory components of that kind that corresponds to a matching space of sensible properties.

In that way, QSS echoes holistic theories of the contents of cognitive states, such as *inferential-* or *conceptual-role semantics* (e.g., Sellars 1956/1997; Block 1986). On these views, a thought's conceptual content is (at least partially) determined by its causal or inferential relations to other thoughts (and, on some versions, its causal relations to behavior or to elements in the environment). The thought that it's raining represents the fact that it's raining because one is disposed to infer this thought from other thoughts (e.g., that the ground is wet) and disposed to infer various thoughts from it (e.g., that one should grab one's umbrella). These views are holistic insofar as a thought's content depends on the thought's relations to other thoughts.

Likewise, QSS holds that the way that a creature sensorily represents a sensible property of a given kind constitutively depends on the way that it sensorily represents other properties of that kind. And there is some experimental evidence for this. For example, Lothar Spillman and colleagues (2000) report evidence of a person suffering from temporary *color agnosia*—a kind of cerebral colorblindness wherein limited damage to the visual cortex results in a selective inability to see particular colors—was incapable of ordering properly the other colors that the individual could see. Such evidence suggests that the loss of one's capacity to visually represent a color affects how one visually represents other colors, just as QSS predicts.

What is important for the view proposed here, however, is that cognitive representation is very different from sensory representation. According to QSS, sensory contents are individuated in a distinctively *quasi-holistic* way—in terms of relations that hold between a specific subclass of states. An experience of red's sensory content is determined only by its relations to other sensory components of experiences of color and not, for example, by its relations to olfactory experiences of odors. Whatever theory explains conceptual content (be it the content of the cognitive components of experience or cognitive states more generally), it will not be quasi-holistic in this way. Even if one holds that the inferential relations between cognitive states determine their contents, such a holism is not quasi in the QSS way: every cognitive state arguably stands in some inferential relation to every other cognitive state. But the sensory components of experience do not stand in inferential relations at all. Rather, they stand in relations of resemblance and difference to one another, as captured by their quality spaces.

Indeed, however conceptual representations operate, one need not be able to have them in order to sensorily represent properties. Again, the capacity for sensory representation is at least partially innate and such states work in a fundamentally different way than cognitive states. Moreover, on the plausible *empiricist* assumption that we acquire concepts on the basis of our experiences with the world, a sensible hypothesis is that creatures first sensorily represent properties before they conceptualize anything (cf. Tye 2005, p. 228). QSS thereby supports the claim that sensory representations are *nonconceptual* in the so-called *state* way (see, e.g., Byrne 2005, p. 233).

There are undoubtedly many objections that one might raise to QSS. Recently, for example, Tyler Burge (2010, p. 494ff) has argued that isomorphism-based theories do not constitute genuine theories of mental representation because he avers that there can be no representation without attribution or representation *as* (2010, pp. 32-44; cf. Nanay forthcoming). According to QSS, however, the sensory components of experiences simply correspond to, and so represent, sensible properties. Sensory representations thereby engender what Fred Dretske (1999, p. 106) has called 'property-awareness', not fact-awareness. The sensory component of an experience of green represents, and so makes one aware of, green alone—it does not represent *that* something is green or something *as* green. On this version of the DCT, all genuine perceptual attribution of properties to objects occurs at the level of cognition. Thus, as Burge (2010, pp. 397-400) might put it, it would seem that the sensory component of an experience of green merely *sensorily registers* green, but it does not genuinely represent it.

But while cognitive representation might require attribution, it is unclear why sensory representation must. One might worry that if a state does not represent objects as having properties, then there can be no misrepresentation. But this is not the case. QSS holds that if a sensory component represents green, then that representation is accurate only if green is present. Moreover, however we describe what the sensory components do, they are quite unlike other merely *subpersonal* states of oneself such as states of one's retina. States of the retina register edges, but we may not want to call them representational. But unlike such states, the sensory components of experience are *creature-level* and can be conscious. Moreover, they are richly integrated into our mental lives. Not only do such components typically or even always accompany the conceptual components of experience, but also together they cause downstream nonperceptual thoughts about what one perceives. We must thus be careful to distinguish the registration role of subpersonal states from the function of creature-level sensory components. If one wishes to dig in one's heels and insist that only cognitive states are genuinely representational, nothing substantive would seem to hang on this choice.[13] But QSS at least seems to put pressure on the assumption that all representation involves attribution.

QSS has many virtues over its atomistic counterparts and is arguably the most promising theory of sensory content currently available. As Rosenthal urges, the view can explain not only the sensory aspects of experiences of external proper sensibles such as color and odor and experiences of external common sensibles such as shape and location, but also arguably bodily sensations such as pains and itches.[14]

Moreover, QSS explains sensory content in a wholly naturalistic way. What determines an experience's sensory content is that component's location within a space of sensory components, which is in turn determined by the creature's discriminatory abilities—which themselves can be characterized in purely physical, nonrepresentational terms. Additionally, like typical varieties of tracking theories of mental content, QSS is compatible with wholly physical characterizations of the sensible properties.

Doubtless much more can be said about the nature of the sensory components of perceptual experience and their contents. But for reasons of space, I cannot explore in detail here the many advantages of QSS nor what may seem to be difficulties with it (for a more complete statement and defense of the view, see, e.g., Rosenthal 2005, chapter 7; for some *prima-facie* objections to it, see, e.g., Prinz 2012, p. 132).[15] Instead, I now turn to how it can help address the Sensory-Content Question.

4. QSS and the Sensory-Content Question

QSS provides the following criteria for what kinds of properties can be sensorily represented:

> **The Family Criterion***:* A property P of type T is represented by the sensory component S of a perceptual experience E only if P falls into a family of T-type (and only T-type) properties, which varies along well-defined dimensions reflected by quality space Q.
>
> **The Modality Criterion**: A property P of type T is represented by the sensory component S of a perceptual experience E only if P is detected via a sensory modality M—that is, M underwrites one's ability to discriminate P from non-P properties in the family of T-type properties.

These criteria provide individually necessary and jointly sufficient conditions for a property to be represented by the sensory component of experience. As will become clear, these are highly related and arguably not genuinely distinct criteria. But it will be helpful to regard them as distinct to make clear why certain properties are not represented via sensory dimensions.

QSS is committed to the Family Criterion insofar as it holds that the quality spaces of sensible properties that individuate sensory contents are restricted to properties that fall into *circumscribed* families of properties. Vision enables us to see the colors, which vary along particular dimensions that characterize the colors *and only the colors*. Such dimensions are *well defined* insofar as they are posited by perceptual psychologists to capture particular ranges of discriminatory behavior. Vision scientists propose that the colors vary along the three dimensions of hue, saturation, and brightness in a particular way to describe how creatures organize the colors (and only the colors) in precisely that way by sight. Naturally, it is an empirical question what the dimensions that differentiate each kind of space are. In the case of smell, for example, there are arguably 17 discrete dimensions (see, e.g., Young et al 2014, p. 6). Whatever these dimensions may be, QSS holds that a property cannot be sensorily represented if it does not fall into such regimented orderings. Thus the color space does not include any noncolor properties. It is compatible with the Family Criterion that a creature be capable of sensorily representing only a particular family of properties via a single sensory modality. But the Family Criterion holds that, for each space, the space involves only *one kind* of property and varies along discrete dimensions that characterize the properties of that kind.

QSS is committed to the Modality Criterion insofar as it holds that the quality spaces that individuate sensory contents are themselves individuated not only by the kind of property in that space, but also by the sensory modalities which provide access to those properties. That is, according to QSS, the quality space of the colors is not simply the quality space of the colors, but the quality space of the colors *detected by vision*. Thus QSS regards spaces of the same kinds of sensible properties detected via different modalities as distinct quality spaces. Consider the fact that we can perceive spatial properties such as shape both by vision and touch. QSS holds that the quality space of shapes generated by vision need not be identical to the quality space of shapes generated by touch. That is, squareness detected via vision occupies a location in the space of visual experiences of shape that need not match the location of squareness detected via touch in the space of tactile experiences of shape.[16]

These two criteria should not come as a surprise. QSS is built on the commonsense observation that our sensory modalities enable us to perceive particular families of properties—and these criteria simply build on this feature of our ordinary conception of perception. But there is in addition experimental evidence for these criteria. There is growing evidence that there are distinct maps of neurons for each of the various modalities in the sensory areas of the brain (e.g., Liang et al 2013). The fact that the neurons in sensory cortex fall into discrete orderings at least suggests that the properties to which they provide access likewise fall into distinct families, as the Family Criterion holds. And there are experimental reasons to accept the Modality Criterion as well. Richard Held and colleagues (2011), for example, found that patients who had recently undergone cataract surgery were capable of distinguishing pairs of objects separately by vision and by touch, but not capable of distinguishing pairs by vision and touch at the same time. These findings are controversial (see, e.g., Schwenkler 2012), but they do suggest that sensory contents are not only individuated by the properties represented, but also by the sensory modalities by which they are represented. QSS nicely captures these results.

These two criteria clearly vindicate the view that low-level properties such as colors, shapes, odors, and tastes are represented via the sensory components of experience. But what about high-level properties? The answer would seem to be clear: such properties are not represented sensorily. While it is plain that people have sensory systems dedicated to the low-level properties of pine trees such as their colors and shapes, it would seem that we do not have sensory systems keyed to pine trees or to causal relations as such. There is, however, much debate about how to individuate sensory modalities (see, e.g., the essays in Macpherson 2011)—and so one might wonder whether this conclusion is too hasty. I return to this worry shortly. But for now it would seem that the Modality Criterion *prima facie* rules out property of being a pine tree as being the kind of property that can be represented sensorily.

Perhaps more importantly, unlike low-level properties such as colors or odors, high-level properties do not seem to fall into the relevant kinds of precisely definable orderings demanded by the Family Criterion. It is rather unclear what dimensions could characterize the quality space of trees and even less clear what dimensions could categorize a space of causal relations. Of course, arborists or tree enthusiasts might offer theoretical reasons to organize trees in one fashion or another—for example, in terms of their genetic similarities. But such spaces are not the relevant kind of space for QSS. QSS generates the relevant quality spaces *by creatures'* *sensory discriminatory behavior*. To build such spaces, we must be able to adjust sensible properties along their dimensions (in the case of color, for example, the dimensions of hue or saturation; in the case of sounds, the dimensions of pitch or timbre) to reflect the *sensed* similarity-and-difference relations in which the properties stand to one another. The space of colors is generated by how they can be visually distinguished.

This is why the relevant spaces involve *circumscribed* families of properties. There is no dimension of a color along which we can vary it so that it will be visually more or less like a noncolor such as an odor, a sound, or a pine tree. We cannot adjust red so that it would begin to become visually indistinguishable from the odor of chocolate. For that to happen, we would have to add dimensions to the color space—namely, odor dimensions—that do not characterize colors and that are not available to vision. And this is why red occupies a location in a space (the color space) that the odor of chocolate does not. Of course, if we adjust redness along the dimensions that in fact characterize the color space—such as its hue dimension—we can make it visually more or less like the other colors, such as orange or purple. In other words, if two properties P1 and P2 fall within the same space, then there should be a dimension (that characterizes properties like P1 and P2) along which we can adjust P1 such that it eventually becomes sensorily indistinguishable from P2.

In the case of high-level properties such as the property of being a tree, by contrast, whatever dimensions trees vary along will invariably overlap with the dimensions that characterize nontrees. Trees visually differ in terms of color, but so do dogs and houses. Thus if one makes appropriate adjustments to a pine tree along its various property dimensions available to vision (e.g., shape, size, color), the tree will invariably begin to look like a dog or a house. The property of being a pine tree, if it sits in any quality space at all, thereby arguably occupies a location in the same space as any other high-level property—and so does not occupy a location in a family of properties circumscribed by discrete dimensions. As a result, the Family Criterion also reveals that the property of being a tree is not sensorily represented.

As noted before, however, not every feature of a sensible property necessarily constitutes a dimension of the space of those properties. As Berkeley (1710/1996, p. 28) famously observed, one cannot see shapes without also seeing the color boundaries that mark those shapes. Nonetheless, it is arguable that color is not a dimension of the shape space as detected by vision. That is, though one cannot see shapes without seeing colors, the dimensions with which we as theoreticians characterize the similarities and differences between shapes does not involve color (indeed, to experimentally test creatures' shape sensory capacities, we simply keep the color of the shapes fixed). Thus someone might object that, though trees may vary in terms of properties that cannot be seen without seeing color and shape—for example, trunk height—color and shape are likewise not properties of the purported tree quality space. Rather, there might be dimensions of the tree quality space, such as foliage color and trunk height, along which trees alone vary and cannot be altered to become indistinguishable from nontrees.

It is, however, at best unclear that there are any such dimensions of trees that are genuinely determined by how trees are visually more or less similar to one another. If one compares trees in terms of, for example, foliage color, then pines trees may seem more similar to elm trees than to maple trees. But if we consider trees with respect to trunk height instead, then perhaps elms seem more like maples than like pines. There is no nonarbitrary way to organize trees in terms of how they visually differ—we must simply choose one among many metrics to privilege and each metric provides a different ordering. In the case of color, by contrast, a creature's sensory discriminatory behavior generates a space of colors that captures the *unique* relations of similarity and difference between the colors. Of course, two colors A and B may be more visually similar to one another than a third color C in terms of, for example, saturation, though A is nonetheless visually more similar to C than B in terms of brightness. Even still, there is a distinctive way—determined by how A, B, and C are detected via vision—in which A, B, and C all relate to one other along the three dimensions of hue, saturation, and brightness.

At bottom, what one is comparing when one compares trees are the ordinary sensible properties of trees, such as their shape and color, and not dimensions of a tree space. There is no tree-specific way in which trees sensibly vary from one another. Trunk height, for example, simply reduces to shape and size. Whereas, in the case of color, the dimensions along which colors vary are purely color dimensions. They characterize the colors and only the colors, and capture how the colors relate to one another as they are discriminated by vision.

QSS naturally does not entail that human adults cannot represent properties such as the property of being a tree in nonsensory ways. It is plain that we can think about, and therefore cognitively represent, trees as trees. Thus if we adopt a DCT, while QSS maintains that the purely sensory components of experience cannot represent the property of being a tree, we can nonetheless maintain that the cognitive components can represent that property. On such a view, perceptual experience can and often does represent trees as trees.

For all that I have said so far, however, if one is not drawn to the DCT then one could maintain that what I have called 'the sensory components of experience' are all there is to perceptual experience and that QSS is thereby the theory of the contents of perceptual experience *tout court*. That is, one could defend the position that experiences represent only those properties identified by QSS. This would be a conservative position, if QSS concerns only low-level properties. But since QSS individuates contents partially in terms of the *sensory* systems that underwrite certain behaviors, it would seem that such contents are the contents of sensations, not perception. Moreover, if the DCT is defensible, then there is no reason to take this hard line. We can happily grant the liberal position that perceptual experiences can and often do represent high-level properties via their cognitive aspects, while respecting the conservative insight that an aspect of experience is specially keyed to a certain subset of properties.

It is worth noting that an interesting consequence of the method outlined here is that it renders the Sensory-Content Question an open empirical matter. While the method clearly vindicates the claim that properties typically characterized as 'low level'—such as colors, odors, and tastes—are represented in the sensory aspects of normal-human experience, it remains open whether or not other kinds of properties might be sensorily represented by other kinds of creatures and even normal human beings. Candidates might include sharks' capacity for *electroreception*—that is, their ability to detect electrical stimuli (see, e.g., Kajiura and Holland 2002)—and the capacities of sea turtles, spiny lobsters, and other aquatic creatures to detect properties of the Earth's magnetic field for navigational purposes (see, e.g., Cain et al 2005). Biologists often assume that such creatures have sensory modalities dedicated to those properties—and if such properties are perceived to fall into families characterized by their distinctive similarity-and-difference relations, then such properties are sensorily represented.

Indeed, nothing in the view blocks the possibility that some creatures could or do sensorily represent high-level properties. This position echoes Bayne's (2009, pp. 388-389) distinction between two kinds of approaches to the Perceptual-Content Question. Bayne notes that the conservative view can come in two varieties that differ in *modal force*: the claim that experiences cannot represent high-level properties and the claim that, in the actual world, our experiences do not represent such properties, although some creatures' experiences do or could do so. I propose a view along the latter lines for the sensory components of experience. If we discover that a creature discriminates among a set of properties that fall into a well-defined family—and it does so via a dedicated modality—then that creature represents those properties via the sensory components of its experience, whatever kind of property it may be.[17]

5. Some Objections

There are, however, several reasons why one might object to this answer to the Sensory-Content Question. For example, one might instead grant that the above criteria specify *some* level of sensory content, but nonetheless object that it is still an open question whether other properties are represented in an additional way that is nonetheless also sensory. Though one might agree that we do not sensorily represent trees via perceptual experiences that have contents individuated by QSS, perhaps we can sensorily represent trees via perceptual experiences with components individuated by some other theory of sensory content. So while QSS may help explain a level of sensory content, it ultimately cannot answer the Sensory-Content Question.

This is fair enough. But I am attempting to give a principled account of what distinguishes sensory content from other forms of content—and it is unclear what other method could accomplish this goal.[18] Moreover, the same kind of criticism could be leveled at any such account. At any rate, I propose that QSS at a minimum carves off an interesting kind of sensory content, though I see no good reason to deny that it provides necessary and sufficient conditions for sensory representation.

More importantly, the Modality Criterion as set out by QSS might seem question begging. Of course, one might agree—and even regard it as obvious—that if we sensorily represent some property then we have a sensory modality dedicated to that kind of property. But, one might argue, we cannot identify what biological systems count as dedicated sensory modalities without first having independent criteria for identifying sensory content. How can we claim that the visual cortex subserves the modality for sensorily representing colors, without first knowing that colors are *seen*? Maybe vision science has been wrong all along, and the primary visual cortex is actually a cognitive system. Or, more plausibly, maybe we do have a sensory modality dedicated to trees.

Again, there has been much debate recently about how to individuate the senses. Some claim that each modality always involves a dedicated organ (e.g., the eyes for vision); others propose that it is a mark of sensory systems that they have some distinctive qualitative character. But, as many have observed, such suggestions are questionable. It is unclear what sense organ figures in proprioception and if, as some have recently proposed, there is so-called *cognitive phenomenology*, then nonsensory states have qualitative character (for an overview, see the essays in Macpherson 2011).

However the modalities may be individuated, QSS gives us reason to think that the issue will likely be worked out in terms of consideration of the Family Criterion. After all, a natural explanation of why sensible properties fall into the relevant families is that they are discriminated via dedicated sensory systems. Arguably one of our main sources of evidence for positing sensory modalities in the first place is observing creatures distinguishing among families of properties in a quality-space-style way. Indeed, Rosenthal and colleagues (Young et al 2014, pp. 6-7) have proposed a method for individuating the modalities along these lines. On this view, two properties are detected via the same sense modality just in case there are sensed resemblance-and-difference relations that link those two properties. Redness and the odor of roses are not detected via the same sensory modality because there is no dimension of redness along which we can vary it such that the odor of roses becomes more similar to redness and eventually indistinguishable from it. Likewise, since we have good reasons to think that trees do not fall into the relevant kind of family, we can conclude that we have no modality dedicated to trees.

This is why the above two criteria for sensory content may not be genuinely distinct. If we individuate modalities in terms of how properties are discriminated as relating to one another, then the fact that a property falls into a well-defined family determined by a creature's sensory discriminatory abilities is not wholly distinct from the fact that the creature possesses a sensory modality dedicated to properties of that kind. Thus it might seem redundant to require that a property be detected by a modality to count as sensible if we already require that it fall into the relevant kind of family.

Even if these two criteria are not genuinely distinct, the crucial point here is that it is open that there are ways to identify sensory modalities, which do not require antecedently settling the Sensory-Content Question. After all, there are many theories of how to individuate the modalities available—and I ultimately wish to remain neutral among them here. Thus while it is plausibly a necessary condition on a theory of sensory modalities that they provide access to properties that fall into regimented families, a range of kinds of evidence might also be relevant to determining whether a modality exists. For example, neuroscientific evidence of localized brain regions sensitive to particular ranges of properties is arguably pertinent. But, again, at least one crucial data point is the kind of discriminatory behaviors creatures engage in—and in particular whether the properties that a purported modality tracks fall into discrete families. An interdisciplinary effort is arguably necessary for individuating the modalities: this kind of functional or behavioral evidence must proceed hand-in-hand with other relevant psychological, neuroscientific, and philosophical considerations to determine which properties are genuinely detected by which modalities.

6. Conclusions

If we are drawn to the DCT, then the answer to the question of what perceptual experiences represent in part depends on the answer to the question of what the sensory components of those experiences represent. And I've offered here a method for answering the latter question, a method that depends on a theory of the grounds of sensory content that I've called 'QSS'. While QSS naturally supports the view that low-level properties such as colors, shapes, odors, and tastes are represented via the sensory components of experience, it renders it an open empirical question what other kinds of properties might be represented sensorily. QSS offers a framework for exploring this issue.[19]

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NOTES

[1] Not everyone agrees that perceptual experiences are representational. According to the so-called *relational* or *naïve-realist view* of perception (e.g., Campbell 2002; Brewer 2006), perceptual experiences are not representations, but relations; on most versions, perception is a relation between perceivers, perceived objects, and those objects' property-instances. But the view that perceptual experiences are representational is widespread and attractive (e.g., Dretske 1995; Tye 1995; Rosenthal 2005; Siegel 2010; Mandik 2012; Nanay forthcoming).

[2] Some proponents of the DCT maintain that the sensory components should be understood in a relational way (e.g., Bengson et al 2011)—and on these naïve-realist varieties of the DCT a similar question arises: to which properties do the sensory components of experience relate us? In what follows, I write in representational terms, but, if one is drawn to this kind of view, it is arguable that one can interpret what I say in a relational way.

[3] Once we draw the distinction between the sensory dimensions of perception and perceptual experience proper, we may begin to lose a grip on what it is for a property to be low level. Most seem to assume that low-level properties are those properties that Aristotle called the 'proper and common sensibles'—that is, those properties tracked by our sensory systems. But if the sensory components represent a seemingly high-level property, then it is not obvious what hangs on whether we claim that those components can represent high-level properties or that the property in

question is actually low level. In any case, the question remains whether or not properties besides those in Aristotle's traditional set are sensorily represented.

[4] For reasons of space, I will not examine the details of the debate over this method. But it cannot answer the Sensory-Content Question. In short, as many have recently urged, conscious thoughts exhibit their own proprietary phenomenology—so-called *cognitive phenomenology* (see, e.g., the essays in Bayne and Montague 2011). Thus it would seem that if a DCT is true then the method of phenomenal contrast cannot distinguish phenomenal differences between perceptual experiences due to the contributions of the cognitive components to perceptual phenomenology from the contributions of the sensory components.

[5] While there is much evidence that perceptual states can and often do occur without being conscious, as in cases of *masked priming* (see, e.g., Kouider and Dehaene 2007) and *blindsight* (see, e.g., Weiskrantz 1997), I restrict my attention here to perceptual experiences. I am confident, however, that the theory of content that I develop can explain the sensory contents of perception, whether or not perceptual states occur consciously.

[6] Proponents of the DCT have offered various ways to understand these components. Reid, for example, maintained that they are a species of belief. Indrek Reiland (2014), by contrast, has recently argued that the cognitive components are *sui generis* quasi-sensory/quasi-cognitive *seemings* that have contents such as this is F.

[7] For a review of various way to explicate this relation, see, e.g., Neander 2006.

[8] Importantly, these spaces of sensory components are not themselves represented in the mind. Rather, like the quality spaces of sensible properties themselves, they are maps or representations of a creature's capacity to engage in a range of sensory discriminatory behaviors. Each sensory component exhibits a location within a space, whether or not a creature is currently having an experience with that component or any other experience. Thus it is no objection to the view that a creature can sensorily represent one property without occurrently representing others (*pace* Prinz 2012, p. 132).

[9] On Rosenthal's account of qualitative character, the reddish character of a perceptual experience of red is determined by that mental quality's unique location in the quality space of mental colors that matches the space of sensible colors. But I gloss the view as a theory of sensory content to sidestep contentious debates about the nature of qualitative character. After all, many conceive of qualitative character as consisting in nonrepresentational *qualia* (e.g., Peacocke 1983; Block 1990). Even so, most proponents of qualia nonetheless grant that perceptual experiences have content—and so require a theory of it. And since Rosenthal is clear that mental qualities are representational, whether or not the relevant spaces of properties of experiences individuate those states' qualitative properties, it is reasonable to hold that they minimally individuate those states' sensory contents.

[10] The relevant notion of matching or correspondence between kinds of spaces is straightforward. The quality space of colors imposes an ordering on the colors, wherein for example the colors P1, P5, and P7 stand in particular similarity-and-difference relations. Since the space of sensory components of color experiences is simply extrapolated from this space, the similarities and differences between sensory components are completely determined by the similarity-and-difference relations that characterize the corresponding space of sensible properties. The resultant space of sensory components thus exhibits an ordering that exactly matches the ordering of the color space. There are sensory components corresponding to P1, P5, and P7—S1, S5, and S7—that stand in similarity-and-difference relations within the ordering space of sensory components that mirror the relations in which P1, P5, and P7 stand.

[11] I construe the presence of the relevant sensible property as a necessary, but not sufficient, condition for the accuracy of its corresponding sensory component because other conditions arguably need to be met. For example, it may be that the sensible property must also be the right kind of cause of the state (cf. Grice 1961).

[12] More accurately, the view holds that there is an isomorphic mapping of sensory components to sensible properties, when the latter are construed as equivalence classes of all physical properties distinguished as occupying that location in the space, and a *homomorphic* (or one-to-many) mapping when the latter are construed as individual physical properties.

[13] In what follows, I continue to write as though the sensory components of experience represent sensible properties, but if one wishes to deny this, one can gloss what I say in terms of the sensory components' registering sensible properties, so long as one distinguishes it from the mere registration of subpersonal states.

[14] For details on how the view applies to the other exteroceptive modalities such as taste and interoceptive modalities such as pain, see, e.g., Rosenthal 2005, in particular chapter 7. For how it might apply to spatial properties, see, e.g., Meehan 2001.

[15] I note that Jesse Prinz (2012, p. 132) cites the above study from Spillman et al (2000) as evidence against Rosenthal's (2005) view, arguing that the fact that the individual was capable of seeing only particular colors shows

that (aspects of) perceptual experience cannot be holistic in this way. But this evidence only shows that the person was able to engage in discriminatory behavior with regard to those particular colors, not that the individual was capable of *accurately* representing them. Thus the evidence supports QSS' prediction that how one sensorily represents a color depends on one's capacity to see other colors.

[16] Thus, while many hold that perceptual contents are *Russellian* insofar as they are individuated by the objects/properties represented only (e.g., Dretske 1995; Tye 1995), QSS holds that sensory contents are *Fregean* insofar as they are individuated not only by the properties represented, but also by the modes of presentation of those properties (for a proposal that holds that perceptual content is Fregean, though in a different way, see Chalmers 2006, pp. 58-61).

[17] And one could make the case that normal adult human beings sensorily represent at least one seemingly high-level property—the property of being a face (cf. Siegel (2010, p. 87, fn. 10), who cites faces as an interesting test case). As is well known, there is growing experimental evidence that human beings have a neural region that functions much like a sensory system dedicated to the processing of information about faces known as the *fusiform face area* (see, e.g., Kanwisher et al 1997; for criticism, see, e.g., Gauthier et al 1999). Likewise, Alexander Todorov and colleagues (e.g., Todorov et al 2008; Oosterhof and Todorov 2008) have recently conducted several studies purporting to show that people visually discriminate faces automatically along particular trait dimensions—what they call 'valence' and 'dominance'—and that these traits can be used to generate a multidimensional map of faces. These facts at least suggest that the property of being a face satisfies the Modality and Family Criteria. One might, however, deny that faces are genuinely high-level properties or maintain that what goes for faces goes for other high-level properties such as that of being a tree. Perhaps faces do not constitute a genuine kind. And it would seem that faces (like trees) vary in terms of color and shape, so it seems that we can adjust a face along those dimensions to make it sensorily indistinguishable from nonfaces such as trees. But it is hard to see why faces are not high level: they are countable and we regularly distinguish them from nonfaces. Likewise, it is not obvious that color and shape are genuine dimensions of the face space. Moreover, whatever dimensions characterize the face space—generated by how faces are *visually* more or less similar to one another—are plausibly not arbitrary in the way that the supposed dimensions of a tree space would be. In any case, I only mean to suggest this as a possibility—an interesting borderline case that illustrates how QSS provides a framework for exploring which properties can be represented sensorily.

[18] Others have offered alternative methods for distinguishing perceptual from nonperceptual representation (e.g., Siegel 2006, 2010; Nanay 2012), but for reasons of space I cannot explore these views here.

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