

Sense Qualities
A paper dedicated to Ronnie DeSousa
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Abstract Sense qualities are known completely and infallibly in the act of perceiving. This principle is well-established in philosophy and presupposed by the methodology of psychophysics. But if sense qualities are known in the same way as other perceptual objects, i.e., by causation from the outside, this would be impossible. Clearly, then, sense qualities are known in perceptual acts, but not by causation from the outside. In this paper, I offer a model inspired by Kant's doctrine regarding space. We know sense qualities because they are parts of the representational scheme employed by the senses.

Ronnie DeSousa has been my friend for more than thirty years and my colleague at the University of Toronto for more than fifteen. He has been exemplary in both roles, but in one way he still makes me a little apprehensive. When I broach an idea with him that we haven't talked about before, he has the disconcerting habit of making a casual and friendly comment that obliges me to start afresh and think anew. I still disagree with him about many philosophical issues, but there are only a few about which I haven't learned from him in this uncomfortable way. It's my honour to dedicate this paper to him. But I do worry that since I have never talked to him about sense qualities, I am risking one of those balloon-popping remarks.

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To sense something consciously is for this thing to appear as if it has a quality—colour, shape, weight, smoothness, etc. And so, when one senses something, one seems to sense a quality also, at the same time and in the same act. But the knowledge one thus obtains of the *quality* is different in kind to that one obtains about the object. As many philosophers have said, one's knowledge of the concrete object of perception is fallible, but one's knowledge of the quality is complete and infallible. Here is an example: the sky looks blue and hemispherical. This is, of course, a false perception—there is no hemisphere there that looks blue. Nevertheless, I apprehend some qualities in this very act: a shade of blue and a three-dimensional shape. I am not and cannot be mistaken about the nature of these qualities; I know them completely when I sense them. How can this be? How can the senses give us this kind of knowledge of anything?

In this paper, I offer a Kantian answer. Sense qualities are classes that sensory systems use to classify stimuli.¹ We know these qualities as a precondition of grasping what perception tells us. This knowledge is in us, not received from the outside. Yet, I shall argue, perceptual content is objective in a way. In effect, my position injects a dose of objectivity into Transcendental Idealism. I believe that Kant should have followed suit.

I. The Subjective Definition of Sense Qualities

The senses present the world to us in ways that we grasp immediately, without the aid of “theoretical” concepts constructed to supplement sensory knowledge. Animals respond to sights, sounds, and smells without speculating about the origins of their sensory states. They implicitly know the significance of what they sense without the aid of extra-sensory conceptual knowledge. Humans are no different. We know what our senses tell us. And this implies that one knows what qualities are attributed to an object, truly or falsely, by a perception.

The self-sufficiency of our knowledge of sensory qualities is not a principle of just philosophy. It is also the foundational principle of the empirical science of psychophysics. This science *defines* sense-qualities by mapping out the similarity structures revealed by subjective responses to physical stimuli. Colour is probably the best-studied example, though similar methods have been used for acoustic pitch, flavour, and many other stimuli.² Here, the underlying empirical method consists in estimating sensed similarity relations among standardized stimuli.

Here's how it goes. Human and animal subjects are presented with pairs of stimuli and their responses are graphically plotted. Humans are simply asked to compare these stimuli verbally—Are they the same or different? Is one of them more or less similar to a third stimulus than to the other? And so on. With animals, the primary differentiation is behavioural response. If two stimuli trigger different associated behaviours, they are discriminable.³ Responses of this kind are

¹ I argued for this position in Parts I and II of Matthen (2005).

² For the similarity space of pitch, see Shepard (1982); of shape, Li et al (2000); of visual texture, Gurnsey and Fleet (2001); of flavour in Scotch whisky, Smith et al. (2017).

³ Usually, the basic unit of measurement of sensory fields is the *just noticeable difference*. For present purposes, the important point about these measurements is that they calibrate physical qualities of stimuli in terms of subject-response. However, it should be noted that there are well-known mathematical problems in this method of calibration, notably the fact that (like the CIE diagram for colour shown below) the resultant similarity mappings display what philosophers call “vagueness” (defined as the intransitivity of indiscriminability). The important point for us is that while this is a limitation on the coherence of using similarity as the fundamental principle of mapping (see Diana Raffman 2015), no psychophysicist would

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aggregated in the graphical form of a “similarity space,” a display in which the distance between physical stimuli is inversely proportionate to the sensed degree of difference between them.

The figure below is a similarity mapping for colour; the wavelengths indicated on the edge of the curve are physical values for monochromatic stimuli. These are plotted in terms of measures of colour sensation on the x and y axes. The x and y values are defined by the subject’s sensory responses; the graphical representation leaves it open whether they have physical counterparts. (Actually, as it turns out, they do not: they depend on the response of retinal cone-cells to an external stimulus, not just on an external physical quantity.)

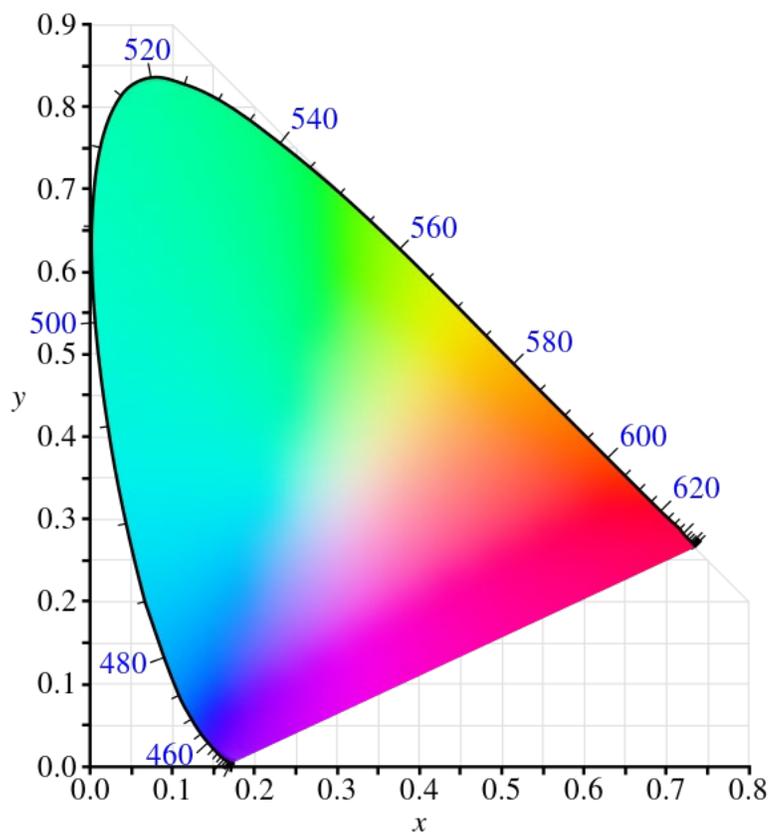


Figure 1: CIE 1931 chromaticity diagram

Sense qualities are identified with points and convex regions in such a similarity space. Sometimes physical sensory response is used as a proxy: colour qualities, in particular, are standardly defined in terms of calculated cone-cell response. The important point for present

suggest that this is a reason to question the basic methodological assumption that sensory fields themselves are subjectively constituted.

purposes is that this method presupposes that subjectively defined sensory response reflects the qualities themselves. Psychophysics seeks to correlate physical quantities with the sensations they evoke in sentient subjects, the latter being the basis of the sense qualities. In short, there is nothing more to determining the ontological structure of a sense quality such as colour or pitch or flavour than that which is revealed by subjects' responses to stimuli bearing these qualities.

Some philosophers claim that this experiential self-sufficiency of our knowledge of sense qualities rests on common practice. Mark Johnston (1992) says that it is part of “how to speak of the colours”—violate the principle and you risk talking about something else. Frank Jackson (1996, 210) follows him and calls it “part of folk theory.” Perhaps this is right. But I have been trying to show that we do not have to accept it merely on the strength of ordinary language or common sense. I would claim that it is justified by philosophical reflection on the nature of sensory knowledge. Moreover, it is implicitly a part of scientific theory.

II. Russell's Principle

Let us say that a *sense quality* is a property of external objects directly known by sense experience alone. Russell (1912, 47) states the point succinctly, using colour as an example: “I know [a] colour perfectly and completely when I see it and no further knowledge of it itself is even theoretically possible.” Similarly, I know “perfectly and completely” the property an object appears to have when I feel its weight, or hardness, or smoothness, when I smell its scent, hear the sounds it makes, and so forth. These qualities are ready to deploy as delivered. No further assembly required. Let's call this *Russell's Principle*.

Russell says that we know instances of these properties—sense-data, according to him—by acquaintance.

I am acquainted with the sense-data that make up the appearance of my table—its colour, shape, hardness, smoothness, etc.; all these are things of which I am immediately conscious when I am seeing and touching my table. The particular shade of colour that I am seeing may have many things said about it—I may say that it is brown, that it is rather dark, and so on. But such statements, though they

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make me know truths about the colour, do not make me know the colour itself any better than I did before. (*ibid*)⁴

This ties in with Gareth Evans's (1982) claim that perception has "non-conceptual content." Russell says that his table's particular shade of brown is "rather dark." This knowledge is implicit in his sensory state; it does not add to it. You need to assemble explicitly represented concepts to arrive at beliefs like that the table is made from mahogany; in particular, you need to have a prior conception of mahogany to do this. But the belief that the shade of brown is rather dark is contained in the sensory state itself; you don't need to understand the concept of a dark colour over and above what you get from the experience itself.

Of course, there are many facts about a sense quality like colour that are *not* revealed when I see it: I do not know merely by looking at a swatch of *canary yellow* that it is the colour of canaries, or that it is called 'canary yellow' in English. But these are not facts about the colour-property "in itself;" they pertain to its relation to other things. What Russell means is that visual experience is both necessary and sufficient for complete knowledge of colour's "intrinsic nature" (as Johnston 1992 puts it). When I look at a canary, it looks a certain shade of yellow. My experience is not sufficient to know that *the canary* is that shade of yellow; the appearance could be misleading. But the experience *is* sufficient for knowing the intrinsic nature of that shade of yellow.

Russell's second-order proposition about sensory qualities is supplemented by a first-order proposition articulated by Paul Boghossian and David Velleman (1989, 83): "one can tell whether two objects appear similarly coloured on the basis of visual experience alone." Now, two objects appear similarly coloured when the colours they appear to have are similar. So, it's a corollary to Boghossian and Velleman's claim that visual experience suffices by itself to determine whether two colours are similar. Nothing additional is needed to verify or validate what experience reveals. The important thing to appreciate here is that though both propositions are stated as they apply to colour, they generalize to *all* sense qualities, including the so-called primary qualities.⁵ Russell's

⁴ I have cut the quotation off to eliminate a rather confusing clause that muddies Russell's thinking a bit. Explaining his meaning would be distracting here, but I don't believe that I am misrepresenting him by the deletion.

⁵ Russell is explicit about this; Boghossian and Velleman, Johnston, and Jackson are not.

Principle and its first-order sibling turn on the self-sufficiency of information about sense qualities received from the senses.

III. Why Russell's Principle is Puzzling

Russell's Principle is both banal and astonishing at the same time. Considered in one way, it is obvious. To say that something is visually experienced a certain way is just to say that it presents certain qualities to visual experience. One cannot be wrong about which quality is presented to experience—barring some small qualifications that are not important to the present context, the content of experience is incorrigibly known. Could there be something non-evident about the qualities it presents? Not on the intended meaning of visual experience, because then only some incomplete aspect of these qualities would be present to consciousness. And if this were so, I would not know these qualities directly by sensing them; rather, I would know them indirectly by sensing aspects, or parts, of them. But this would mean that these aspects or parts are the qualities I sense directly. So, assuming that a quality is directly experienced—assuming for instance that colour is directly experienced—it is completely available for inspection. This simple argument shows why Russell's proposition is banal.

Considered in another way, though, Russell's principle is astonishing. For if we perceive sense qualities in the same way as we perceive material objects—that is, if confrontation with an object is our model of perceptual acquaintance—then our knowledge of sense qualities should be as fallible and incomplete as our knowledge of material objects. This is exactly how Frank Jackson (1996) understands the difficulty. “A necessary condition for [an experience] to be a presentation of a property is that there be a causal connection” (*ibid*, 200).⁶ And a few pages later: “We typically count things as red just if they have a property that interacts with normal humans to make objects look red in such a way that their so looking counts as a presentation of the property to normal humans” (*ibid*, 206). It seems, in short, that we can be wrong about anything we experience because of their effect on the senses. How then can sensory experience give us complete and infallible knowledge of sense qualities?

It is well to note, in this context, that as the methodology of psychophysics suggests, sense experience gives us a great deal of second-order knowledge about sense qualities. Over and above

⁶ Odd that he should say this, since it is obviously false: we can experience red even when nothing red is in front of us. But still, perceptual confrontation is the model he is using.

knowledge about sense qualities, sense experience is also sufficient to know certain relations among sense qualities that fall under the same determinable. For example, experiences of canary yellow and scarlet are sufficient for certain knowledge that the first is lighter than the second. Experiences of these two colours and of orange are sufficient to know infallibly that the first two are less similar to one another than either is to the third. To put this in philosophical jargon: the similarity space of colour is perfectly and completely given by visual experience of colour, as is the position of various colours in this similarity space. And the same goes for other sense quality fields—tactual and visual texture, weight, smell, auditory pitch, etc. How can this be so? How does it sit with the fallibility of perceptual knowledge?

IV. The Sensory A Priori

The proposition that strikes us as paradoxical is that our senses offer us infallible and complete knowledge of an external entity, in this case, a higher order object—a quality or a relation. At first sight, our immediate, complete, and infallible grasp of anything extra-mental seems miraculous—Johnston (1992) even labels Russell’s Principle “Revelation,” suggesting that it invokes some kind of mystical knowledge akin to religious faith.

Strange and counterintuitive as Russell’s Principle is, it has a famous precedent in Kant’s treatment of space. Kant was concerned with a number of questions about space that are not relevant to my present concern, but there’s one strand in his thinking that I would like to follow. He claims that perceptual experience (or “intuition” as he called it) of space affords us “apodictic certainty” of certain propositions concerning its structure—for example, that it is Euclidean.⁷ This echoes the certainty Russell proclaims about similarity relations among sense qualities—sense experience gives us certainty about the similarity structure of colour. Kant argued that this the certainty of intuition is not analytic—you cannot get from the definition of space that it is Euclidean. Again, the same goes for the sense qualities. You cannot get from any plausible definition that the flavour of limes is more similar to that of lemons than to that of paprika. Yet you know this with certainty.

⁷ “Geometrical propositions [such as the triangle inequality] can never be derived from the general concepts of line and triangle, but only from intuition and indeed *a priori* with apodictic certainty” (*Critique of Pure Reason* A24–5/B39–40).

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Now, as Jackson insists, this certainty cannot be explained if we assume that we perceive space in the same way as we perceive material objects—perceptual knowledge of external objects is not certain. Kant proposes, therefore, that our intuition of space “has its seat solely in the subject, as its formal constitution for being affected by objects . . . [or] the form of outer *sense* in general” (B41).⁸ When I see x to the left of y and y to the left of z , I always see x to the left of z . I don’t arrive at ideas of transitivity *through* such intuitions. Rather, Kant asserts, the idea of space “has its seat in the subject” as a precondition of intuiting such relations. This, he says, is the only way to explain why transitivity is known with certainty. This is the idea I’d like to adapt to the understanding of Russell’s Principle.

I showed earlier that sense qualities are grounded in sensory similarity. I will now supplement this with an additional postulate: the sensory similarity space of a perceptual system embodies its classificatory system. To account for our knowledge of sense qualities, we should not look to information *received* by our sense organs. We should look instead to the form in which this information is presented to us by our perceptual systems. Sensory systems have world-facing receptors that are excited by physical stimulation received from the outside. Given this input, they classify external stimuli in a regimented form. Sense qualities are defined by this form. For example, in figure 1, light of 520 nm produces a sensation that corresponds to an x -value of ~ 0.1 and a y -value of ~ 0.85 . These values define the class to which light of 520 nm is assigned.

The colours and other sense qualities are, in this manner, equivalences among subjective responses to stimuli. You know what *blue-green* is because you know implicitly in the act of sensing *blue-green* what the associated x - y values are. You know this with certainty because these responses reside in you as the subject, as Kant held about space. These x - y values are the form of colour perceptions. The same goes for the other sense qualities; they too are perceived in a regimented form.

To sum this up: sense qualities are similarity-groupings created by our own sensory systems. We do not know these groupings by perceptual confrontation, i.e., by receiving information about them from the outside. Rather, we know them because that’s a precondition of understanding the significance of our own perceptual states. In parallel with Kant’s views about

⁸ I take my quotations of Kant from Andrew Janiak (2022), who uses the Guyer and Wood translation.

space, these states are proprietary responses that have their seat in the subject. This is why we can possess certainty about them.

V. Objectivity

Kant held that space is not an external object. As I understand his position, he holds that it is the representational scheme by which we sense the locations of external objects. This representational scheme is Euclidean, according to him. Now, consider what Newton and Einstein considered to be space: these theorists disagree about whether this entity is Euclidean. Kant's theory has no bearing on this dispute. The disagreement between Newton and Einstein is about physical distances (as manifested in gravitational fields, for example). Kant does not have an opinion about the space that these distances jointly constitute; it is not the space he is (or should be) talking about. But now a question arises. Suppose x looks as if it is to the left of y : how shall we assess the truth of the appearance? We can't look to the positions of x and y in the space of theoretical physics because spatial intuition isn't about physical space. So where should we look? A similar question arises about the sense qualities. The Canadian flag looks red: is it really red? If *red* is a class defined by my sensory system, it's unclear where I should look to determine the answer to the question

The question that I would now like to ask is whether this Kant-inspired treatment of sense qualities makes them purely subjective. And this breaks down into two further questions.

First: Are my perceptions subjective? For instance: Does the truth of my perception of the Canadian flag as red depend purely on my own sensations? Or is it objective in some important respect?

Second: Are the similarity spaces employed by my sensory systems subjective? Does the greater perceived similarity of squares to rectangles than to circles purely an artefact of my sensory representation scheme? Or are they objective in the sense that my sensory categories are identical with objective similarities?

Before I address these questions, let me make the point that the outputs of our sensory systems are not simply sensory states. The function of these systems is to mediate timely adjustment to a changing world, and so they are linked to immediate responses to the worldly facts that they monitor. Think, for example, of reflex action: something suddenly appears in your peripheral vision, and you duck. Here, the visual system doesn't just register the event; indeed,

you may only marginally be aware of the object itself. More importantly, it initiates the reflex response. Accordingly, I would like to propose that in general, sensory systems are not merely creators of experience. They are initiators of response. It doesn't matter for my purposes whether this broader function is attached to the sensory system itself or to an associated system. The important point for me is that if sensing leads to an inappropriate response then it is objectively wrong. If your senses make you duck and there's nothing to avoid, they were objectively wrong.

For simplicity's sake, let us say that conscious sensing is tied to *epistemic* response.⁹ When a sensory system registers that x appears F , this also leads the subject to adjust (or adjust the strength of) her beliefs about x (and hence to be poised to report that x is F); to identify x with (or distinguish it from) something she has encountered before; to infer by learned association that x is G ; and so on. Many of these epistemic responses to sensory appearance are innate or modified-innate; they are not willed but are rather integrally tied to the sensory process. In short, we possess an internal model of the state of the world outside ourselves; in conjunction with belief-formation capacities, our senses play a role in updating and maintaining this model. Again, the function of sense perception is not confined to the conscious effect of outside circumstances through a sensory organ; it is also an initiator of epistemic response.

In accord with this broader perspective, I suggest that the form of sense qualities has two components—a phenomenal similarity structure and an epistemic response structure based on the phenomenal similarity structure. Earlier, I alluded to the psychophysical methodology of constructing similarity spaces for sense quality fields. This methodology probes the structure of sense qualities through the epistemic responses to which they are tied: verbal report in the case of humans and learned associations in the case of non-human animals. Psychophysical similarity spaces correspond to phenomenal similarity; as such they are accessible to the subject. But these similarity spaces also control response; psychophysics assumes that this function is close enough to phenomenal similarity to justify using it as a probe thereof. When two sensory states are phenomenally similar, the epistemic responses associated with them are similar. This gives us a way to address the question whether it can be objectively true that the Canadian flag is red.

Let's say that property Q is *objectively attributable* to s if s is (or is not) Q independently of how anybody thinks about or experiences s . If a sense quality Q is objectively attributable to s

⁹ We could broaden the kind of response involved without damage to this perspective.

and if s is perceived at one time as Q and a moment later as not- Q , but without changing over this interval of time, then both cannot be right since this would imply that s was both Q and not Q . The same holds of *relations*: a sensory relation (such as *difference* in colour or weight) is objectively attributable to a pair of objects if that pair of objects stands in that relation independently of how anybody thinks about or experiences them.

Now, are sense qualities objectively attributable to external entities? I would say that the answer is ‘yes.’ Suppose that in sodium light, I experience the Canadian flag as a bright shade of orange, though in usual circumstances, it looks red. Given that this is an attribution that resides within my sensory system, how can it be validated or faulted? What would we compare the appearance to? It seems it isn’t open to us to say that it’s wrong because the flag is not actually orange—what makes it not actually orange if my colour vision system assigns it to the orange part of colour similarity space? There seems, at first glance, to be no further fact of the matter that we can appeal to here, no objective standard on which to ground truth and falsity.¹⁰

This is where the idea of an epistemic response structure is useful. If the flag looked orange, certain epistemic responses would follow—in particular, a weakening of beliefs that depend on its looking red. For example, the orange appearance would (simultaneously) weaken all of the following beliefs: that the flag is red, that the object that I am looking at is the Canadian flag, that things tend to stay the same colour unless physically changed. It is wrong to weaken these beliefs. So, it is wrong for the flag to appear orange. In short, the senses have a job to do and the appearance of the flag as orange interferes with them doing that job. This is an objective assessment.

I conclude, then, that despite their residence within sensory systems, sense qualities are objectively attributable to external objects.

VI. Primary Qualities

What about the sense qualities themselves? Can they be mind-independent? The difficulty is that sense qualities are completely known by experience. Mind-independent entities cannot be known in this way. Of course, sense qualities may be co-extensional, or even non-accidentally co-

¹⁰ Does it make sense in Kant’s view to say that x wrongly appears to the left of y , or further from y than z ? I can’t find anything in the *Transcendental Aesthetic* that bears on the question. He is so focussed on the question whether *space* is real that he doesn’t seem to attend to whether and how spatial relations could be grounded in extra-mental reality, whether that reality is space itself or something else.

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extensional with mind-independent properties. But their essences are specified differently. Sense qualities are non-conceptually defined by our experience of them; mind-independent qualities are not. This implies that even if co-extensionality is non-accidental—a product of evolutionary adaptation, for example—it is still logically contingent. If it is logically contingent that properties P and Q are co-extensional, then $P \neq Q$. It follows that sense qualities are not the same as mind-independent qualities. This is the consequence of Russell's Principle.

My proposal has been that we know the sense qualities because they are classifications within a broader classificatory scheme which also includes similarity relations. Russell himself has what one might call a qualia-based account: sense knowledge is acquaintance with sense-data. Johnston (1992) gives a qualia-based dispositional account of *colour*: colour-qualities are dispositions to evoke qualia. I believe that my account yields a better understanding of the epistemic role of sense perception in the natural world, but let's put this aside for a moment. What I would like to emphasize here is that this argument is quite general. Russell's Principle extends to *all* sense qualities, not just those that are plausibly taken to be "secondary." Any attempt to accommodate the Principle should also be general.

Sense qualities are ontologically separate. They are not the same as physical qualities. This said, they may closely correspond to mind-independent qualities. The usual basis for such a correspondence is a *higher order similarity*. The sense qualities that fall under a determinable—a property field like colour, texture, flavour, etc.—are structured by certain relations. For example, sounds (i.e., sound properties) are ordered by phenomenal similarity with respect to pitch, loudness, and timbre. Each such property field has physical causes: sounds are caused by physical events that produce acoustic waves. These physical causes may also be ordered, though this time by physical (not phenomenal) similarity. A higher order similarity is a similarity of the phenomenal and the physical orderings. In the case of sound: (1) pitch corresponds (also with qualifications) to frequency; (2) soft-to-loud sounds correspond (roughly, discounting contrast effects, etc) to small-to-large amplitude of the corresponding acoustic waveform; and (3) timbre is a function of frequency mixture. These, however, are only rough similarities; they mask notable dissimilarities. Pitch rises as frequency rises, but two notes an octave apart sound more similar than either to the fifth in between them; this goes against (1). As well, loudness is strongly modulated by ambient sound levels; timbre is modulated by similarities in pitch. In sum, there is a rough, but by no means exact, higher order similarity between sensed sound and its physical counterpart in acoustic waves.

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The point to be made about these discrepancies regarding sound is that perception is an active process. It manipulates the incoming signal in order to extract from it a useful epistemic response. The utility of response depends on the lifestyle of the organism. So, each organism has a sensory representation scheme that suits its own environmental niche. This representational scheme may transform physical similarity in order to do this. Its sense qualities are in this manner non-objective.

Are there sense qualities that are so constrained by external reality that the higher order similarity is perfect? If so, they are what Locke called “primary qualities.” Primary qualities embody classification schemes that match physical qualities. What kind of constraint would produce such a match?

Higher order similarities exist when one of two circumstances obtains. First, when the way we pick up information about a sense quality is constrained by the quality itself. Consider tactile shape. We feel the shape of objects by running our hands over them; when we do this our hands follow the shape of the objects they are in contact with. This creates a higher order similarity between a train of tactile sensations and the shape of the object. We rely on this higher order similarity when we perceive the shape. Second, when the way we use the sense quality depends on a higher order similarity. Take shape again. We perceive and deploy shape information in a two-way interaction between touch and vision. To switch back and forth between visual and tactile information, our perceptual systems rely on higher order similarities between touch, vision, and the object. (Note that I am not saying that there is a direct similarity between these disparate media. My claim is that each has characteristics that are ordered in a certain way, and that the ordering relations are different but similar.)

Let me summarize this train of thought. Sense qualities are groupings of stimuli created by what I have been calling sensory representation schemes. These representation schemes are completely known because knowing them is a precondition of the autonomy and self-sufficiency of the senses. This account makes sense qualities non-objective—they are subject-generated equivalencies. However, external circumstances may constrain how sensory representation schemes operate. So, though these schemes operate internally and “reside in us,” they may reflect external circumstance to some extent. This is the basis for the designation of some qualities as “primary.” But primary qualities are mind-dependent too.

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