## MATERIAL OBJECTS AS THE (ONLY) SINGULAR SUBJECTS OF MULTIMODAL PERCEPTION

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*Abstract* The higher animals need to identify and track material objects because they depend on interactions with them for nutrition, reproduction, and social interaction. This paper investigates the perception of material objects. It argues, first, that material objects are tagged, in all five external senses, as bearers of the features detected by them. This happens through a perceptual process, here entitled Generalized Completion, which creates the appearance of objects that have properties that transcend the activation of sensory receptors. The paper shows, secondly, that material objects are *privileged subjects* for perceived motion and interaction. That is, they are perceived as subjects for these properties while their parts seem to be subjects only derivatively. Material objects are the only perceptual subjects that are both multisensory and privileged.

*Keywords* material objects; object perception; amodal completion; multisensory perception; visual objects; haptic perception; sounds; smells; Tyler Burge; Casey O’Callaghan; Clare Batty.

Each of our external senses is dedicated to certain sensory *features*: vision is concerned with colour, shape, and size; audition with pitch and volume and certain phonetic units; touch delivers information about shape, size, temperature, texture, and weight; and so on. What I want to discuss in this paper is a ubiquitous framework that perception builds for these sensory features: we often, or even dominantly, perceive them as jointly bound to singular subjects.[[1]](#footnote-2) Colour, for example, is dominantly perceived as belonging to a spatially delimited subject that could at the same time be perceived—the very same thing—as emitting a sound, being of a certain temperature, and having a certain smell. These multisensory logical subjects are moreover *privileged subjects* for motion and action. That is, they seem to move, act, and be acted upon as whole units— their parts seem to move because *they* do, not the other way around. These privileged multimodal subjects are *material objects*. (I’ll say more about what material objects are in section II.)

Of course, material objects are not the only bearers of perceptual properties. Liquids and gases have sensed properties as well. However, the logical structure here is different. With certain exceptions (that I’ll discuss briefly in section IV below), fluids are generally perceived as agglomerations of parts that have the feature in question, rather than as single causally coherent units that move, act, and are acted upon as wholes. The whole of a body of water has no greater claim to be the bearer of these properties than its parts, and no greater perceptual salience as such.

The feature-bearing role of material objects is a significant feature of our perceptual systems (and those of other higher animals). The classic philosophical analysis—what Imogen Dickie (2010) calls the “Old Empiricist View”[[2]](#footnote-3)—locates all perceptual features in a spatial “field” or treats them as simple non-located events. This analysis is often correct—think of visual phenomena like beams or flashes of light and non-visual properties such as sounds and smells. But it overlooks the crucial role of material objects as subjects for sensory features.[[3]](#footnote-4) My aim in this paper is to explain this structural feature of perception.

### External Perception

Material object-perception is a kind of external perception.[[4]](#footnote-5) So, I’ll start with this.

To arrive at an understanding of external perception, let’s start with a characterization of sensing.

An organism *O* senses *C* if a part of *O*’s body autonomously gathers and deploys information that emanates from an instance of *C*, and by doing so, enables *O* to respond in a functionally appropriate manner to that instance of *C*.

I sense *warmth*, for example, when temperature sensors in my skin are activated by ambient heat and my touch-sense translates the output of these receptors into an awareness of warmth that enables me to respond as is appropriate to warmth occurring in my vicinity—and when all of this occurs autonomously, i.e., without the action of my conscious reasoning and volition.[[5]](#footnote-6)

Understood this way, one might think that *external* perception is just the gathering of information that puts the subject in a position to respond to *external* circumstances. For since the correct response to external circumstances requires information about those circumstances, one might think that it requires external sensing. But this would not be correct. For external response may be mediated by *proximal* sensing. Here’s how. Let *C* be some external circumstance to which an organism *O* can respond by sensing. Let *R(C)* be the information-carrying effect that *C* has on sensory receptors in *O*’s body. It could be that *O* is able to respond to *C* by monitoring *R(C)*.[[6]](#footnote-7) Here, *R(C)* carries information about *C*, but *O* does not extract this information; *O* is sensitive to *C* only by being sensitive to its own receptors.

This kind of proxy-for-external-sensing is how plants respond to their environments. Consider, for example, a plant growing a root. Roots tend to put out more lateral roots on the moister than on the dryer side of their bodies; this is how they respond to moisture-gradients in the soil. This growth-pattern is mediated by the suppression of a cell-reproduction factor in dry conditions, resulting in fewer lateral roots on the dry side of the root-body (Orosa-Puente et. al. 2018).[[7]](#footnote-8) Water-contact or dryness on the root-surface *carries* information about moisture in the soil beyond—distal moisture is the cause of proximal moisture. The plant, however, does not extract this information. It responds just to conditions on its root-surface. This is the kind of case that demonstrates that we do not need to posit external sensing to explain externally directed functioning. Tyler Burge (2010, 422) sums it up correctly: “There is no explanatory need to attribute representation of distal attributes, as distinguished from registration of proximal stimulation.”

Because of examples like this, external perception cannot be defined in terms of the target of response. It has to be defined in terms of *sensory content* (or “representation,” in Burge’s terminology). External perception has *content* that is “about” the external world. Though roots of plants respond to distal moisture gradients, their sensory organs do not represent these gradients; they only represent water in contact their own body-surfaces (if they represent that). However, when I hear a man singing on the street, I hear the sound coming from a more or less determinate place distant from me. The content of this auditory experience is external because it does not make me aware of an occurrence in my own body. Rather, it presents me with something happening a certain distance away.

Given that proxies-for-external-sensing exist, how can one be confident of this assessment? How can one rule out the possibility that when I seem to hear a distant singer, I am really aware only of a proximal event—for instance, the vibration of my cochlea—and that my mind passes by dint of repeated exposure from this cochlear event to the idea of something happening far away? Once again, the best answer to this question comes from Tyler Burge (2010). My awareness of the singer is *perceptually constant*. That is, there are changes in my cochlear condition as I listen to the singer—he sings different notes at different volumes; there are other noisy things on the street, and these pollute the sound stream from the singer; I move about my business and receive the sound stream from different distances and angles. But through all of these changes, the perceptual impression of a song sung from the same distant spot persists. There is, in short, a changing effect on my perceptual receptors, but a single continuing experience of the same singer at the same distant spot. This constant perceptual impression cannot simply be the same as awareness of the cochlear disturbance because its content does not vary, though the cochlear disturbance does. Despite variation in the impact on my auditory receptors, the impression co-varies with the distant object and informs me of it.

Now, it has been argued that perceptual constancy is learned, or in some other way acquired by repeated exposure. It’s not my intention to contest this. All that I want to insist on is that the perceptual constancy is an autonomous function: it is not a matter of *my mind* moving discursively from cochlear disturbance to distant cause—perceptual constancy is not (as a referee helpfully remarks) a matter of *conceptual inference by the subject*. In fact, it couldn’t be, since I have no awareness of cochlear disturbance. My phenomenal experience is of a song sung by a single singer at a distant location. Whether it is produced by an innate process or by one modified by perceptual learning, it is this experience that allows me to form beliefs about the singer, respond to him with pleasure, and so on. This is what makes it external perception.

### Material Objects

Now, what is the function of external perception? When is it required?

I believe that one can shed some light on these questions by considering the perceptual needs of higher animals. Most animals move about their environments under their own power—they are *motile*. By contrast with sessile organisms—organisms that are not self-propulsive—higher animals such as birds and mammals seek out resources at a distance from themselves. While plants reproduce by courtesy of winds or cooperative animals that spread their seed, higher animals have actually to *do* something to find reproductive opportunities—they have to seek out sexual mates, and to do so, they have first to identify them as such. Animals forage and hunt; plants merely follow nutritional gradients and absorb whatever such tropisms bring them into contact with. Animals recognize landmarks and navigate by them; plants obviously have no need for such things. For all of these functions, external perception is required. But mere external perception does not suffice—it is not enough to identify various perceived locations as external to the subject and to recognize some pattern among them. Additionally, certain material objects have to be identified as occupants of external space—food, mates, predators. So, the spatial field of perception must be so organized as to identify continuities and causal links among points that identify them as belonging to coherent material objects.

What is a material object? Minimally, it is a continuous body of matter that retains its form by internal causal connections. A rigid body is an example. Internal forces ensure that it retains its shape under external forces—when it is pushed with sufficient force from one side, for example, the whole of it moves. When it ingresses another material object—for example, when a fork enters an omelette—it doesn’t seem as if a new composite material object has been created—at least, not unless other conditions are met. A rigid body acts *as a whole*. A baseball bat has properties as a whole that determines what happens when it hits a ball; when it breaks, the joint weight of its fragments and the shape of the spatial volume they occupy have no such relevance.[[8]](#footnote-9)

Now, not all material objects are rigid, but they are all causally unified in such a way that they are the bearers of properties as wholes. My dog is not a rigid body, but his shape deforms only in certain ways: he retains his form in a broader sense of this term. As well, he is a privileged subject. *He* runs and eats: the movements of his limbs and his mouth are seen as his movements.

The perceptual needs of higher animals go beyond identifying points in space as external and attributing qualities to them. For knowing the occupants of these spatial points is not sufficient for knowing what will happen when one interacts with them. Knowing that a baseball bat-shaped volume of space is occupied by bits of wooden matter is not sufficient for knowing that there is something there one can pick up and swing. Knowing that there is a dog-shaped collection of animal parts in my vicinity is not sufficient for knowing whether it is capable of barking and jumping.

Now, of course, everybody knows that there is a difference between a material object and the collection of its detached parts. And everybody will allow that everyday activities demand that one know which of the two one is confronted with. The empiricist line on this is that one is able to discern one from the other by discursively applying general differences that one has learned to employ in these contexts. I contend that this empiricist line is inadequate for two reasons.

The first is that there is a perceptual phenomenology of whole objects—this is well known from the work of Gestalt psychologists and that of developmental psychologists who have tried to show how this phenomenology emerges in infants. As Jean Piaget (1954) writes,

A world without objects would not present the character of spatial homo­geneity and of coherence in displacements that marks our uni­verse. Inversely the absence of “groups” in the changes of position would be equivalent to endless transformations, that is, continuous changes of states in the absence of any permanent object. (*ibid.* 3)

In other words, external perception is not merely point-perception; it includes the perception of connected wholes, or “groups.”

The second reason is that the phenomenology Piaget describes is functionally dictated. External perception would be of no use to higher animals without material object perception. For as I argued earlier, motility introduces a complexity of action to animal life—animals that move under their own power use that movement to find food and mates and to avoid predators Since the main point of perception beyond the skin is interaction with other material objects, it would be functionally useless to perceive externally—to have the capacity for perceptual constancy, for example—without perceiving whole material objects. Thus, the “groups” of which Piaget talks above are not merely spatial groups; they are, and must be, causally connected groups. Piaget’s paradigm is based on infants learning by active search, prehension, and interaction with objects. Obviously, these activities require objects to display a certain “coherence in displacements.” But they have to be more than spatial “groups.” For as Piaget writes later (*ibid* 96), an object is a “truly coherent whole:”

only that phenomenon constitutes a real object which is connected in an intelligible way with the totality of a spatio-temporal and causal system (*ibid* 87)

and

the object is fully constructed in correlation with causality to the extent that this coordination of schemata results in the formation of an intelligible spatio-temporal world endowed with permanence (*ibid* 88)

### Generalized Perceptual Completion

Object-perception has most thoroughly been studied in the case of vision. And this is appropriate, since vision is the modality best adapted to the identification of material objects. Because vision is essentially spatial—information coming from the eyes is spatially laid out from the very beginning of the visual process—its representational structure matches the spatial character of material objects, which occupy connected and discrete places. For this reason, the visual system’s algorithms for object-identification are not replicable in the other modalities. In this section, however, I will be concerned with a strategy that does generalize. I call it *Generalized Completion*. I will use it to shed light on multimodal object perception.

Vision is atomistic in the following sense. Every visible object in three-dimensional space projects to a collection of retinal cells. So, given the two-dimensional retinal image, one can ask which collections of retinal places are projections from a single visible object. Classically, in Gestalt psychology and its successors, this question is investigated by inquiring what relations among a collection of retinal-image places mark that collection as the image of a single material object. For example, it is claimed that when we see segments of a smooth curve fractured by continuous line-segments, we see the continuous segments as objects in front of and occluding a single object with the shape of the fractured curve. (See Figure 1.) Similarly, when a “moving” point disappears and another one later appears in a dynamically plausible continuation of the interrupted trajectory, this is seen as a single object passing behind an occluder and reappearing later. These are principles of completion and continuity among collections of visible places, and it is a commonplace of visual psychology that it is through the application of such principles that the visual system is able to identify and distinguish material objects.



Figure 1: Amodal completion: occlusion inferred by continuity.

Now, topological principles such as continuity and completion are not free-standing. Vision employs them because they enable it to work backwards from a retinal pattern to the kind of object that (likely) projected to that kind of pattern. In keeping with this reconstructive function, the phenomenology of visual object-perception corresponds to the inferred object, not the retinal pattern. In Figure 1 (or, rather, in real world presentations of this pattern), the visual phenomenology is that of an oval (or possibly an ellipsoid) *behind* three rectangles. To put it in a way that sounds somewhat paradoxical, this object *looks* as if it has parts *that cannot be seen*. This is the phenomenon that psychologists call “amodal completion,” the term ‘amodal’ marking the fact that the continuity of the interrupted contour is visually experienced, even though the occluded parts have no effect on visual receptors. The hidden parts are *visually* experienced in the sense that the impression essentially depends on *looking* at Figure 1—just as the impression of the non-occluded parts does. But the phenomenology of the hidden parts is different—their visual characteristics (such as colour) are not experienced.

This is the phenomenological pattern I want to generalize. When a perceptual system processes incident information *I*, and therebyregisters the presence of an object of type *T*, perceptual *experience* will be of an object of type T, with obscured features essential to *T* registering merely as present, without their specific characteristics being presented. *Amodal* completion inserts features that would have affected sensory receptors if they hadn’t been hidden.[[9]](#footnote-10) But in what I’ll call *Generalized Completion*, some of the inserted features are of a kind that *cannot* have a causal effect on sensory receptors. For example, material objects look causally coherent and resistant to ingress—these are modal characteristics and as such they do not affect the eyes. This is the result of data-processing by the visual system.[[10]](#footnote-11)

### Generalized Completion in Non-Visual Modalities

Generalized Completion suggests a different approach to the perception of material objects than the one that Casey O’Callaghan (2016) develops. O’Callaghan starts with the observation that the senses have proprietary objects. Vision and touch target material objects, he says, but we “hear sounds, smell odors, and taste flavors”—not material objects (*ibid* 1270). But, he continues, we need objects common to the senses to accommodate how the senses work together. For example, to accommodate perception of a noisy car moving, we need to see and hear a single object. But if auditory objects are sounds, and sounds cannot be seen, what could the common object be?

So far, all of this is both correct and insightful. The problem comes when O’Callaghan insists that the common object could not be a material object—we don’t hear the *car*, he says. Why not? Because “humans do not hear spatial edges, surfaces, occlusion, or rigidity” (1275). He is claiming, in short, that since audition cannot spatially delimit material objects, it cannot present a material object. Accordingly, he proposes that the common objects of multisensory perception are “mereological sums” of objects peculiar to each modality. What we see is a car participating in an “event-like individual” that also has a sound as a constituent part (1282–83). My question is whether this really captures our phenomenology. When I see and hear a passing car, I seem to perceive one and the same individual in both modalities. I don’t merely perceive the sound *fused with* a unimodal *visual* object.[[11]](#footnote-12)

My proposal is that in cases like this our perceptual systems infer a common subject by a process of Generalized Completion. What I seem to see and hear is a single object that has unseen and unheard properties. My perceptual system autonomously inserts into perceptual awareness a multimodal, not a merely visual, subject for both the visual and auditory properties that I perceive. This common subject is a material object.

Consider a case like this. I am listening (live) to an orchestra. At a certain point, a flute enters. I can’t quite locate the player by audition alone: she’s somewhere off to the left, but that’s as close as my hearing lets me get. I look closely at the orchestra, however, and I see the flautist: I can tell which player she is because of how her body moves as she plays her part. Suddenly, the flute part becomes more precisely located; its location autonomously snaps to the visually identified orchestra member. Both sight and hearing now identify *her* as the source of the melody.[[12]](#footnote-13)

The principle that lies behind this audio-visual coordination is simple. In order to play the melody, the flautist performs certain actions with her head, upper body, and arms. These visible bodily motions reveal her as a material object and locate her in space. The coordination of the two modalities employs detailed spatial information that audition by itself cannot access. This affects auditory phenomenology—it seems to me as if she *over there* is producing sound. I don’t *hear* the spatial edges of the flautist, it is true. O’Callaghan is obviously right about this. And I don’t *see* the melody she is playing. I also do not see the back of her head or her causal coherence. The properties that make her a material object do not have a direct effect on my visual or auditory receptors. Nevertheless, I have a somewhat indeterminate awareness of these properties. Generalized Completion presents me with a material object as the source of the sound.[[13]](#footnote-14)

The same kind of thing can be said about smell. In section VII, I’ll discuss how smell helps us identify *types* of material substance. Here, let me make a remark about how we determine that it inheres in a material object. Consider the act of bringing something to your nose to smell it. Touch reveals this thing as a solid material object (perhaps containing a liquid). The smell gets stronger as you bring it closer, and weaker as you put it down. It is thereby revealed as an object that has a smell—that is, the smell is revealed as attached to a moving object, rather than free-floating in the way that the smell of flowers is after you have used a spray air-freshener. Again, Generalized Completion is at work. You perceive a material object that has a smell.

Now, this account of perceiving smells in material objects is, in effect, contested by Tyler Burge (2010, 415). He would say that when I bring something to my nose, I am *locating* a smell by the use of “a homing or beaconing technique that serially follows directional intensity,” a procedure not unlike that followed by plants to grow roots on their moister side. (See section I above.) I’ll argue in section VII below that this is an oversimplification—but put this aside for now. My point for the present is that even if it *is* mere “homing or beaconing,” bringing something to my nose allows me to do more than simply *locate* the smell: it allows me to identify the object in my hand as the source of the smell. And this is a *perceptual* achievement—that is, it is an attribution of a sensory feature to a material object autonomously by a perceptual system.

Now, to be fair to Burge, he does say, a couple of paragraphs earlier, that smell is non-perceptual “unless . . . supplemented by input from other sources.” I assume that he would point to my kinesthetic awareness of my hand moving toward my nose as an instance of “input from other sources.” If this is his position, he subscribes to a sceptical attitude taken by Clare Batty (2014), who writes: “everyday olfactory experiences do not possess . . . robust spatial representation . . . and, as a result, (do) not allow us to single out particular objects in our environment.” Batty proposes that olfactory experience has a “weak form of abstract content,” in which “there is something or other “here,” or “at” the perceiver, that has certain olfactory properties.” Burge’s position is more exclusionary, but he agrees that we don’t ever have olfactory experience of an object or of a substance. It is only a slight exaggeration to characterize their position this way: I never smell a mango or a glass of whiskey; I simply experience a smell in myself (Burge) or “at” my body (Batty).

I would argue that this line of thought is unduly restrictive. Briefly, all of the senses use awareness of own-body movement as a way of enriching the spatial information available to them when the body is stationary. Vision uses motions of the eyes, head, and body to gather three-dimensional information; audition supplements these motions with visual information (as we saw above); touch uses the movement of an object against the skin to distinguish bodily stimulation from external stimulation (see section VI). So, if you exclude multimodal perception all of the senses become, at the very least, less robustly perceptual.

To summarize: All of the sense-modalities that receive information from the external world are capable of representing that information as emanating from sources in the external world. They normally do this by cooperating with each other and with kinesthesia. As a result, they do not merely *locate* these sources of information in the outside world, but also *attribute* them to discrete material objects.

### Four Kinds of Perceptual Objects

(i) Material objects are, as I said at the beginning, multimodal subjects for perceptual features. They are, moreover, privileged subjects for motion and causal agency in the sense that they, not their parts, are felt in perceptual awareness to be the primary movers. That is, their parts are felt to move and to act because they are as wholes. They appear this way because they appear to be causally coherent.

Now, material objects are not the only subjects we perceive—we also perceive liquids and ephemera such as shadows and beams of light (Matthen 2018). And in non-visual modalities, we perceive sounds, smells, and flavours. These individuals lack one of the two perceptual characteristics of material objects. Either they are not multimodal, or they are not privileged subjects.

(ii) Start with liquids: perceptual experience doesn’t present them as privileged subjects. That is, the parts are not experienced as moving or acting because the whole is. For example, when I take a shower, the column of water doesn’t feel as if it is acting on me as a whole—there is nothing unifying in my experience of the water comparable with how the bar of soap feels in my hand. And, except insofar as it is contained by a material object, I do not see a quantity of water as having a rearward-facing surface, as available for interaction, or as resisting ingression by other material objects—i.e., not as a single whole. Finally, I do not experience it as the subject of properties in multiple modalities. I see water flowing from a faucet and hear it splashing in the sink, but I don’t perceive these events as characterizing the *column* of water taken as a whole, in the way that the sound of a car and its visible movement characterize it as a whole. A waterfall makes a rushing sound all over, but again no particular bit of it, including the cascade-as-a-whole, is privileged as the primary noisemaker. It seems to make a noise because its parts do.

There is an illuminating qualification that must be made about this generalization about liquids. When they naturally clump, for example when they fall in drops, they look more like material objects. And the more viscous they are, the more they clump. Thick paint coalesces into blobs, spreads in step-like streams, forms relatively long-lasting ripples when stirred, forms non-vertical streams when poured with an unsteady hand. These movements are closer to those of material objects than those of less viscous liquids. They allow us to perceive viscosity (van Assen et al 2018). In short, more viscous liquids are more causally coherent and are consequently perceived to be more like material objects.

(iii) Next, consider visual ephemera such as cast shadows, rainbows, and beams of light. These are by-products of boundary-drawing for material object-perception, and as such they are privileged subjects. They look like material objects in certain respects,[[14]](#footnote-15) but they also look unlike them in others. Shadows, for example, are delimited, but they don’t look causally coherent—it is no surprise when a moving cast shadow is momentarily stretched and distorted as it passes over something. Nor do they look as if they have a rearward facing side. Shadows and beams of light don’t look as if they resist ingression. Crucially, these objects are not subjects for multisensory feature attribution. They are not perceived as sources of sound or smell.

(iv) Finally, non-visual objects. These too are privileged subjects. As O’Callaghan (2016) writes:

. . . sounds are public objects of audition, even if they are merely audible. They are audible bearers of perceptible attributes such as pitch, timbre, loudness, and duration. Multiple distinct sounds are audible at a time, sounds persist and survive change, and sounds can occlude and mask each other. You can attend to a sound in contrast to its features, its location, the material object that makes it, or its audible background. You can track a sound over time and form audition-based demonstrative thoughts about it. . . (*ibid.* 1274-75)

However, sounds are unimodal and fall short of material objects in this other critical dimension.

### Point-Content and Object-Content: The Case of Touch

We examine things closely by holding and handling them. We visually examine them by turning them over in our hands; we listen by holding them up to our ears; we smell by bringing things up to sniff. These activities demonstrate that the things we touch are also the subjects of features in other modalities. And our manner of handling these things shows that they are privileged subjects of dynamic properties—the thing that is in our hands is the very thing we visually examine or listen to or smell. In short, they manifest both hallmarks of material objects identified in the preceding sections: they are privileged subjects for properties in different modalities.

There is, however, a special problem understanding our perceptual grasp of the object of touch. Typically, we hold an object by contact with just a small portion of its surface. How then do we know by touch that this is a complete material object? At first pass, this is just another instance of Generalized Completion. Remember how this principle was used to address O’Callaghan’s worry that “humans do not hear spatial edges.” Why not say that here too, the containing contours of material objects are inferred by the tactile system, even though they are not in contact with the skin. This is good, as far as it goes, but traditionally, another difficulty has lurked. Many philosophers of perception assume that touch is an *internal* sense-modality—that what we feel by touch is not an external object, but rather pressure on the skin. In order to accommodate both this supposed bodily focus, or interiority, of touch and also the fact that we are in contact only with fragments of external objects, some suggest that our ideas of tactile objects are constructions from sense data*.*[[15]](#footnote-16)

Now, in order to assess this thesis, we must note first that touch displays a certain duality. A stimulation applied to the skin can be felt as something happening *on the skin*; this is generally known as “tactile” sensation. But if the subject moves her body against the intruding stimulus, or pushes back against it, the *stimulus* is (also) felt *externally*; this is known as “haptic” perception.[[16]](#footnote-17) So, think about feeling a pen in my grip. If the pen lies passively between my fingers, I may feel only the pressure at my fingertips. This is tactile sensation; it is interior. However, when I *grip* the pen—exert pressure on it in order to use it—I also perceive it as an external object. When kinesthesia and proprioception, or awareness of the movement, muscular effort, and position of my body, combines with touch, I am aware of the external stimuli in contact with my skin.

Now, think again of what I feel in my hand when I use the pen. My fingers are exerting pressure inwards and correspondingly, they feel the resistance of this object. Moreover, each digit feels the reciprocal pressure of the others through the object of interest. Together, these coordinated feelings add up to perceiving the object as a coherent whole. This suffices for being aware of it as a privileged subject, even though the details of its shape are not known. This is Generalized Completion.

Now, what about each tactile experience taken in isolation? The experience of pressure on each digit is comparable to that if it were to press down on a hard object. Now here’s the point. Even if it makes sense for the atomist to treat of these feelings separately—i.e., without taking the coordination between them into account—each still feels as if it is in contact with a material surface. Taken by itself, neither reveals a single material object that has the thickness of the pen, for you need the two sensations together for that. But each reveals a material object nonetheless, for it is only material objects that exert resistance when you press down on them. What my thumb in isolation reveals when I hold the pen is a hard something—something that is a subject for the tactual property of hardness. In short, the thumb reveals the generic material-object status of the pen, without revealing the more specific information about its size or shape.

I conclude that *haptic perception* is distributionally about material objects from individual points of contact on up. It is extremely contentious to hold that feeling the pen is a simple construct from perceptions at minimal points of contact—coordination is needed; simple concatenation does not suffice. But bracketing this point, the fact remains that I perceive the pen as a material object even at the minimal point of contact. Notice that in arriving at this conclusion, I have not assumed that every perceptible logical subject is a material object. Rather, my premise was that anything that resists pressure from my body is a material object.

### Type-Identifying Material Objects: Smell

I argued earlier that smell can be experienced as emanating from material objects when we move relative to those objects. I want now to conclude by arguing that smell is externally directed in another way. It identifies *types* of material object.

Let’s start with the phenomenon.

(i) You turn on the coffeemaker in your kitchen. As the coffee begins to brew, you smell it. You also start the butter going to make yourself a fried egg. You smell the butter as well.

(ii) Later, you head off to the office. You walk by an idling delivery truck, and you smell its unpleasant exhaust-fumes. At the same time, you walk by the open door of a coffee shop. You smell the coffee while still aware of the fumes.

In these incidents, you identify coffee by its smell in two different contexts. There are two points here of note.

First, you experience the same smell—the smell of coffee—in two quite different contexts. This is, as I will explain in a moment, an instance of *perceptual constancy* and thus a sign of the external significance of olfaction.

Second, the smell of coffee is, on both occasions, a *single* smell (though, no doubt, a bit different on the two occasions, since the coffee you brew is different from the one in the coffee shop). The generality of this kind of non-decomposability with regard to smells indicates that as a modality it is directed toward *types* of substance—coffee, butter, diesel fumes—not toward putative subordinate features by which types of substances are identified. In other words, the primary olfactory identificatory marker of coffee is the smell of coffee—not components of that smell.

*Perceptual Constancy* Why do I say that (i) and (ii) together constitute perceptual constancy? In any sense-modality, each sensory receptor is affected by any stimulus to which it is “matched.” As noted earlier, vision is spatially laid out at its front end, and touch is laid out by bodily parts. This aids in the separation of visual and tactile stimuli. In the other modalities—audition, taste, and smell—the receptors are affected by everything in range.[[17]](#footnote-18)

Taking olfaction in particular, the smell-receptors are affected by coffee and sizzling butter in (i) and by coffee and diesel fumes in (ii). That is, the activation level of each olfactory receptor is simply a sum of effects created by these two odorants (and any others in range). The total stimulatory pattern is quite different in the two incidents. Yet, olfaction is able to extract a commonality—the activation pattern characteristic of coffee. This is classic perceptual constancy. At its front end, the olfactory system’s activation is a sum; yet olfactory experience reveals the type-identity of one of the summands. In other words, given two multidimensional vectors, (a + b) and (a + c), the system somehow figures out the value of a.

Tyler Burge (2010, 415) contradicts this, writing that “constancy [is] not prominent in the workings of [smell]” because “proximal registration of a chemical blend suffice[s] for most purposes.” It’s a little difficult to figure out what he means because this seems so obviously false. Not only do we extract the smell of coffee from the “blend” of coffee and diesel, but also, we are able to discern the smells of coffee and hazelnut in a flavour-blend, and to distinguish and match these components with those in a coffee plus orange blend. Clearly, the proximal registration of these blends does not “suffice” for olfaction in these cases; the olfactory system breaks down the proximal stimulus into its distal components.

Burge seems to be influenced here by a misleading hypothesis about memory. He writes:

Ordinary language sometimes portrays the taste of wine or the smell of banana as perception. Such cases are usually to be assimilated to belief and propositional memory derived from non‐perceptual sensory states. The representation is not at the purely sensory level. The sensory system responds to certain types of proximal stimulation that in fact come from such things as wine or bananas. Discriminations can be either generic or fine‐grained. But, except for the special case [of locational constancy] noted with respect to smell, I know of no perceptual constancies in the gustatory or olfactory sensory systems themselves. (*ibid.*, 416)

Now, memory could function in two ways in smell (and flavour) identification. One way, which is irrelevant, though it may be what Burge has in mind—is “semantic.” That is, I might put a verbal label (“coffee”) on a smell because I remember that this is what it is called. This, as I say, is irrelevant because what is important is the awareness and re-identification of the smell of coffee, which precedes tagging it with a label.

The second way memory could be involved is sensory and non-conceptual. When I smell coffee, I am aware of a sensory profile. In the incidents recounted above, I am aware of a similar profile rising and falling in strength as I move about the kitchen or the sidewalk. When I get closer to the coffee, the olfactory components that I remember in the smell of coffee, get stronger; when I move away, those components get weaker. Similarly, in the coffee-orange mixture, two olfactory profiles with which I am familiar seem to be added together. This kind of pattern-recognition is of a piece with what Stevenson and Wilson (2007) propose.

The brain appears to store previous patterns of glomerular output, so that when a new output arrives it may be matched to all previous encodings. If there is a good match, we consciously experience a discrete odour, distinct from its background and discriminable from other odours. It may or may not be identified (named). Where the input is unfamiliar, our experience is vague and ill-formed and the odour is hard to discriminate from other unfamiliar odours. (*ibid.*, 1824)

I know of no evidence that suggests that this kind of memory should be “assimilated to belief and propositional memory,” as Burge says. The olfactory system seems autonomously to incorporate such traces of earlier encounters.[[18]](#footnote-19)

*Perceptual Unity* I come now to my second point. The smell of things like coffee are perceived as single smells. As Stevenson and Wilson (2007) write:

Aged Rioja red wines have over 800 volatile components, of which approximately 60 have odours detectable by humans. Parmigiano Reggiano cheese has around 160 volatile components with nearly 30 of those odorous. Despite these incredibly complex stimuli, our percept is largely unitary (despite anecdotal evidence and folklore to the contrary), and we perceive a specific red wine or cheese. (*ibid.* 1822)

This is a contrast with vision, where the characteristics of a type like *dog* or *cat* are discrete: legs like so, fur like this, etc. For even if the visual appearance of types of things are somewhat inexplicitly stored, there is no single non-decomposable look-of-a-cat in the way that there is a single non-decomposable smell-of-coffee. This is a powerful point. The experiences of smell generated by the olfactory system are not just the components of a classificatory system; they are actually type-markers.

What should we take away from these reflections on olfaction? First, that olfaction is external perception by the criteria I borrowed from Burge: it is perceptually constant. That is, olfaction represents the presence of something external. So far, I agree with Batty (2010). Second, given awareness of one’s own movement when one manipulates or homes in on smells, one can be aware of a smell as an attribute of a particular material object. Here, I depart from Batty, who argues, largely on grounds that overlook multimodal perception, that smell cannot be localized except “at” the perceiver herself. And finally, to this particularity, add the unitary nature of smells that arise from *types* of material substance. From this, I conclude that we smell instances of these types.

### Conclusions

At the beginning of this paper, I said that the external senses characteristically provide us with awareness of material objects and their properties. I have tried to clarify and explain this claim. I showed how vision provides us awareness of properties beyond those that affect the eyes by the information carried by light. Then I proposed a process of Generalized Completion by which non-visual modalities generate experiences of material objects by recruiting sensory exploration using the perceiver’s own body. Finally, I discussed the somewhat special cases of touch and smell. Touch is special because its object-awareness is bottom-up and atomistic. Smell is special because its experiences are of types of material substance. Flavour-perception might be similar in this respect.[[19]](#footnote-20)

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1. We also perceive detached sensory properties—the warm light of the early morning, the rustling of a breeze in the forest, the warmth of a fire, and so on. [↑](#footnote-ref-2)
2. Dickie concerns herself with vision only, about which the “Old Empiricist View” asserts that “visual experience presents us with an array of *features* laid out around us and developing over time” (emphasis added). In a footnote, she mentions that Locke also includes “sounds, and some tangible qualities.” These are not, in the traditional view, “laid out around us”—sounds because they lack location, and tangible qualities because they are within us—false, but this is what the Old Empiricist View holds. [↑](#footnote-ref-3)
3. See Clark 2004 a, b and Matthen 2004 for a discussion of the issue. [↑](#footnote-ref-4)
4. Our own bodies are material objects, but we perceive them in a different way—from the inside. I am excluding this. [↑](#footnote-ref-5)
5. Perhaps, *I* don’t sense warmth unless I am aware of it; *I* can’t respond without such awareness. But my thermoregulatory system may autonomously deploy warmth-information by activating my sweat glands, for example, and this can happen without my awareness of either the condition or the response. This shows that sensing need not be whole-organism sensing—thermoregulatory sensing can occur autonomously in my body without *my* being involved. This is a complication that need not detain us here. [↑](#footnote-ref-6)
6. Sense-datum theorists take a position of this sort: they hold that all response, including response to external circumstances, is mediated by a proximal effect of those circumstances. [↑](#footnote-ref-7)
7. See McElrone et. al. 2013 for an introductory overview of water-uptake in plants. [↑](#footnote-ref-8)
8. Elizabeth Spelke (1990, 48–54) discusses rigid bodies as paradigms of material objects. [↑](#footnote-ref-9)
9. There is amodal completion in audition and touch. Albert Bregman (1994) showed that when audition completes a partially obscured continuous melodic line, what we seem to hear is a completed melodic line with partially determinate gaps. And Geldard and Sherrick (1972) showed that when widely separated parts of a subject’s arm are stimulated with a series of taps, she experiences a connecting series of “phantom” taps. [↑](#footnote-ref-10)
10. Burge (2010, 444) rebukes Elizabeth Spelke for suggesting that essential properties of material objects such as *cohesion*, *boundedness*, *solidity*, and *spatiotemporal continuity* are imperceptible*.* He points out that the attribution of such features can be “generated within perceptual systems.” I have tried to accommodate a correct premise of Spelke’s thinking without taking on her mistaken inference that the representation of these properties is post-perceptual. [↑](#footnote-ref-11)
11. It is interesting to note that audition does seem to have access to some of what we would otherwise take to be visible properties: for example, Carello et al (1998) show that subjects were able to estimate by sound the length of dropped dowels made of the same wood. Of course, this effect depends on the shape and rigidity of the dropped objects, and thus on the test objects being material objects. [↑](#footnote-ref-12)
12. Spelke et al (1983) suggest that in adults (but not in infants), *impact* is highly relevant to the audio-visual localization of sound: the location of a bang snaps to a visible collision. It’s worth remarking that percussive sounds are the products of material objects colliding, and so Generalized Completion takes some credit for creating this appearance. A natural extrapolation would suggest that when you see a moving object interact with a stationary one—for example, a suitcase being pulled over a bumpy floor—you hear *the suitcase* making a noise, not the floor. [↑](#footnote-ref-13)
13. My point here is an extension of Burge’s criticism of Spelke: see note 10 above. [↑](#footnote-ref-14)
14. Shadows shouldn’t be thought of as completely ephemeral. Cast shadows resemble and are causally connected to their objects and thus they serve as sources of information. See Pavani and Galfano (2015) for a review. (Here, I am grateful to a referee.) [↑](#footnote-ref-15)
15. O’Shaughnessy 1989 and Martin 1992 start from the interiority of touch but offer nuanced accounts of *attention* that pioneer the exteriorization of this modality. Unfortunately, this is a wrong direction: the exterior targets of touch require more than a shift of attention. See Matthen 2021 for a critique. [↑](#footnote-ref-16)
16. See Fulkerson 2015 and Matthen 2021 for further details and discussion. [↑](#footnote-ref-17)
17. This is also true of audition: each hair-cell emanating from each part of the cochlea reflects the sum-total of sound at the frequency specific to that hair-cell. However, audition has some spatial discrimination, sounds have natural resonances, and voices utter phonetic streams that have natural unity conditions determined by phonetics, lexemes, and meaning. These conditions make certain decompositions of the sound stream more natural than others. [↑](#footnote-ref-18)
18. Stevenson and Wilson suggest one other mechanism. We get adapted to smells very quickly—the newly arrived guest smells the cooking right away, but the host has long become unaware of it. So, smells have a window of sole presentation. [↑](#footnote-ref-19)
19. Thanks to Casey O’Callaghan for illuminating and helpful discussion. [↑](#footnote-ref-20)