AUSTRALASIAN JOURNAL OF PHILOSOPHY, 2017
https://doi.org/10.1080/00048402.2017.1329329

Marking the Perception–Cognition Boundary: The Criterion of Stimulus-Dependence

Jacob Beck

York University, Toronto

ABSTRACT

Philosophy, scientific psychology, and common sense all distinguish perception from cognition. While there is little agreement about how the perception–cognition boundary ought to be drawn, one prominent idea is that perceptual states are dependent on a stimulus, or are stimulus-dependent, in a way that cognitive states are not. This paper seeks to develop this idea in a way that can accommodate two apparent counterexamples: hallucinations, which are *prima facie* perceptual yet stimulus-independent; and demonstrative thoughts, which are *prima facie* cognitive yet stimulus-dependent. The payoff is not only a specific proposal for marking the perception–cognition boundary, but also a deeper understanding of the natures of hallucination and demonstrative thought.

ARTICLE HISTORY Received 26 September 2016; Revised 26 April 2017

KEYWORDS perception; cognition; stimulus-dependence; stimulus-independence; hallucination; demonstrative thought

1. Introduction

There is an intuitive difference between perceptual states such as seeing an object as red or hearing the note of a trumpet, and cognitive states such as judging that justice is fairness or imagining your deceased grandmother. Scientific psychology seems to recognize a distinction between perception and cognition as well. The chapters of introductory textbooks are often divided into chapters on perception and chapters on cognitive processes such as memory and reasoning. A similar division accompanies many undergraduate courses in psychology, divisions within psychology departments, and researchers' self-described areas of expertise. Various debates in philosophy and psychology also presuppose the existence of a perception–cognition border, including debates about the cognitive penetrability of perception, perception's ability to justify beliefs, the richness of perceptual content, attention's influence on perceptual appearance, and the existence of social perception. Yet, in spite of all this, the question of how best to draw the perception–cognition border has received surprisingly little sustained attention. As a result, we lack a fully reflective understanding of a border that is central to many projects in philosophy and psychology, as well as to common sense.

My primary aim will be to flesh out one proposal to demarcate perception from cognition: perceptual states are dependent on a stimulus, or are *stimulus-dependent,* in a

way that cognitive states are not. Although this proposal should have a familiar ring,[1] there has been little explicit discussion of how it might be systematically developed. On what type of stimuli does perception alone depend? And what type of dependence is at issue? Nor has there been much discussion of whether and how this proposal can handle two trouble cases: hallucinations, which are *prima facie* perceptual yet stimulus-independent; and demonstrative thoughts, which are *prima facie* cognitive yet stimulus-dependent. This paper will explore how these questions and trouble cases might be addressed.

While the question of how stimulus-dependence can be used to mark the perception–cognition boundary will be the main plot, the need to address the two trouble cases will generate two subplots. The first concerns the proper classification of hallucination. It is often assumed that hallucinations are non-veridical perceptions. But, on reflection, it might not be clear why they shouldn't be classified as maverick imaginations instead. I'll argue that some hallucinations are, in fact, imaginations, but that others are perceptions. And I'll say something about how to distinguish between the two types of hallucination.

The second subplot concerns the nature of demonstrative thought. Many demonstrative thoughts are, in some sense, 'perceptually grounded'. I'll offer a suggestion about what perceptual grounding comes to, and about how demonstrative thoughts can be perceptually grounded without being perceptions themselves.

2. Motivations

There are several reasons to think that a perception–cognition boundary that is drawn in terms of stimulus-dependence will prove to be of theoretical interest. First, it promises to capture the intuitive idea that perception is essentially *sensory*. It is dependent on sensory stimulation and the use of one's sense organs in a way that cognition is not. Thus, even if perception involves a type of objectivity that is lacking in sensation [Burge 2010a], it is still like sensation and unlike cognition in so far as it is tethered to the senses.

Second, the appeal to stimulus-dependence reflects the important idea that cognition involves a type of freedom from the here-and-now that is lacking in perception. What unites various cognitive states—memories, imaginations, beliefs, etc.—is that they can run offline, in the absence of sensory stimulation, in a way that perception cannot.

Third, imagistic memories (for example, of your grandmother's voice) and imagistic imaginations (for example, of what a new haircut would look like) are in some respects similar to perceptions. They are modality specific in so far as they are happily characterized as visual, auditory, etc.; have similar phenomenal characters; recruit overlapping brain regions [Kosslyn et al. 2006]; and, arguably, also have similar formats and contents [Nanay 2015, 2016]. We might even call them perceptual, in a broad sense of

[1] In one form, the idea that perception is stimulus-dependent traces at least to Locke's [1689] account of the formation of simple ideas, which are the 'effects of certain powers in things' [II.xxxi.2] that 'enter by the senses' [II.ii.1]. In psychology, it has echoes in the pioneering work of nineteenth-century psychophysicists such as Weber and Fechner who sought to characterize law-like relations between stimuli and percepts. More recently, Prinz [2006], Camp [2009], Burge [2010a: 378], Beck [2012], and Nanay [2015: 1729] all invoke the concept of stimulus-(in)dependence while discussing perception and/or cognition.

'perceptual'. Still, there is a narrow sense of 'perception' that counts perceptions as different in kind from imagistic memories and imaginations, and one promising way to capture that difference in kind appeals to the idea that perceptions are stimulus-dependent.

Finally, recent empirical work provides evidence for a range of representations that differ intuitively from perceptions but are input-driven, have a non-propositional format (that is, lack the sentence-like structure that is commonly attributed to propositional attitudes), and are the outputs of special-purpose mechanisms that are at least partially encapsulated (meaning that their operations are insulated from most of what goes on elsewhere in the mind) [Gallistel 1990; Carey 2009; Shea 2015]. For example, there is evidence that humans and other animals use *analogue magnitude representations* to track numerosities, durations, distances, rates, and other magnitudes [Mandelbaum 2013; Beck 2015]. These representations operate offline in a way that perception does not. For instance, an organism might use its analogue magnitude representations of the rates of return of various distal foraging sites that it visited in days past to decide where to forage today [Beck 2012: 586]. Stimulus-independence thus offers a promising way to understand the sense in which these representations are non-perceptual.[2]

These considerations are intended to motivate the exploration of a perception–cognition boundary that is drawn in terms of stimulus-dependence. They are not intended to establish that such a boundary exists. Nor should they be construed as denying that other useful perception–cognition boundaries can be drawn by using other properties (for example, phenomenology, format, modality specificity, or modularity) or clusters of properties. In fact, given the wide array of debates that presuppose a perception–cognition boundary, it would be rather surprising if there were only one legitimate way to draw the boundary.[3] But I strongly suspect—and I take the four considerations adduced above to suggest, even if they don't establish—that the concept of stimulus-dependence will play a central role in characterizing at least one theoretically important perception–cognition boundary.

I have been proceeding on the assumption that there is at least one way of drawing a principled border between perception and cognition. Yet a number of thinkers have recently flirted with eliminativism about the border [Clark 2013; Lupyan 2015; Shea 2015]. These thinkers are motivated by evidence that information processing in the brain does not proceed in a purely bottom-up or feed-forward manner; top-down (and sideways) influences are pervasive. For example, believing that bananas are yellow allegedly makes banana-shaped objects look more yellow than they would otherwise (Hansen et al. [2006]; but see Zeimbekis [2013]). Some are also motivated by the predictive coding framework, which takes the minimization of global prediction errors (the difference between the predicted and actual inputs at all levels of processing) as its governing principle, and consequently places no in-principle limitations on top-down influences. These claims about top-down influences are controversial and have been challenged [Firestone and Scholl 2016]. But even if one sets aside that controversy, the

[2]One might also seek to distinguish analogue magnitude representations from perceptions because they are amodal rather than modality specific [Beck 2012: 587; Burge 2014: 574]. It is controversial, however, whether perception is always modality-specific [O'Callaghan 2015; Briscoe 2016, forthcoming]. And, as we observed in the previous paragraph, imagistic memories and imaginations are modality specific but not perceptions.

[3]Pluralism about the perception–cognition boundary is defended by Phillips [ms], although he congenially argues that stimulus-dependence is a common thread that runs through the boundary in all of its forms.

presumption that top-down influences are antithetical to a perception–cognition boundary really only makes sense if one assumes that the boundary has to be drawn in terms of encapsulation—for example, so that a mental state counts as perceptual just in case it is the output of a (certain type of)[4] Fodorian module. But there are clearly other options, including the stimulus-dependence analysis that I'm championing and which is not at all in tension with the existence of top-down influences. Even if you were to visually perceive a white banana as yellow only because you believe that bananas are yellow, your visual perception could be stimulus-dependent all the same. Dependence on a stimulus does not preclude simultaneous influence from cognition. By appealing to stimulus-dependence, we can thus mark the perception–cognition boundary without prejudging on-going empirical debates about the extent to which perception is encapsulated.

Two final preliminaries. First, there is a difference between providing necessary and sufficient conditions for perception and/or cognition and providing an account of the perception–cognition boundary. A successful account of the perception–cognition boundary will tell us whether a mental state is perceptual or cognitive, provided that we *already* know that it is one or the other (but not which). Such an account thus need not distinguish either perception or cognition from other sorts of mental (or non-mental) states. For example, it need not distinguish perception from sensation or cognition from emotion.

Second, the hypothesis that perception and cognition are both representational is widespread among psychologists and philosophers, and I will assume it here. Its acceptance is not universal, however, as it is rejected by direct realists, who take perception to be a type of acquaintance with the world that is unmediated by representation. Although I will not argue the point here, I agree with Burge [2005, 2010a] that direct realism fits poorly with our best scientific approaches to perception. Thus, my question is that of how the concept of stimulus-dependence can be used to draw the perception–cognition boundary from within a representational paradigm. I believe, however, that much of what I will say could be co-opted, with suitable amendments, by direct realists who were interested in using stimulus-dependence to draw the perception–cognition boundary.[5]

3. Stimulus-Dependence

Perception often involves two types of stimuli: a *distal stimulus* that is the particular represented, and a *proximal stimulus* that directly impinges on the perceiver's sense organs. For example, if you see a body as red, then the body and its redness are distal stimuli, and electromagnetic radiation is the proximal stimulus. Or if a dentist touches a tooth with her gloved finger and feels its solidity, then the tooth and its solidity are

[4]The qualification is necessary if there exist modules that are cognitive rather than perceptual—say, cheater detection modules [Cosmides 1989] or reorientation modules [Hermer and Spelke 1994]. In fact, since we're seeking an *analysis* of the perception–cognition border, the qualification is necessary if cognitive modules are so much as *possible*. One could address this concern by holding that the perceptual modules are the ones with stimulus-dependent outputs. But one would then want to know whether the appeal to stimulus-dependence isn't doing all of the work.

[5]In fact, there is at least one respect in which direct realists might have an *easier* time using stimulus-dependence to draw the perception–cognition boundary. In so far as they embrace disjunctivism, they could welcome the result that hallucinations aren't perceptions because they aren't stimulus-dependent.

the distal stimuli, and the pressure that the tooth exerts on the dentist's finger is the proximal stimulus. (In some cases the distal and proximal stimuli may amount to the same thing.) Intuitively, there is a way in which perceptual states, but not cognitive states, are dependent on a causal link that derives from the distal stimulus and is mediated by the proximal stimulus. You cannot veridically see a red body or hear the note of a trumpet if there are no red bodies or trumpets around to be seen or heard, or if your eyes are closed or your ears are plugged, although you can veridically think about either while submerged in a sensory deprivation tank.[6]

One complicating factor is that such causal links play an important role in the genesis of many veridical cognitive states. I come to believe veridically that there's olive oil in the cupboard by opening the cupboard and looking, and so my belief is triggered by the distal stimulus of olive oil and mediated by the proximal stimulus of light. Likewise, I form a veridical visual memory of olive oil in the cupboard, based on an earlier time when the olive oil was present and reflected light that stimulated my eyes. Causal links that derive from a distal stimulus and are mediated by proximal stimulation are thus responsible not only for veridical perceptions, but also for certain veridical beliefs and memories.

Another complicating factor is that the causal links that support veridical perception allow for a certain amount of slack. It is plausible that you can veridically see a tree by virtue of a causal link that, in one sense, extends only to the tree's surface, and that you can veridically see a star that no longer exists, by virtue of light that was emitted from the star millions of years ago but is only now reaching your eye. Thus, regardless of how the notion of a causal link is strengthened to exclude beliefs and memories, it should retain enough 'give' to accommodate the veridical perception of whole bodies and distant objects.

One promising suggestion focuses on the *sustaining* role that present proximal stimulation plays in veridical perception. If you close your eyes, you will no longer veridically see the olive oil in your cupboard, although you will continue to have veridical beliefs and memories about it. Let us therefore propose that the occurrence of a mental state is *stimulus-dependent* just in case it is causally sustained by present proximal stimulation. If we take Ψ to range over perceptual and cognitive state (event, process, etc.) types, we can then offer the following simple (too simple, as we shall see) formulation of the perception–cognition boundary.

> S-D Simple: Ψ is perceptual if, necessarily, all veridical occurrences of Ψ are stimulus-dependent; otherwise, Ψ is cognitive.

Note that, because stimulus-dependence is defined in terms of present *proximal* stimulation and does not constrain how the causal link extends to the distal stimulus, S-D Simple allows that a whole body can be veridically perceived by virtue of a medium that is causally affected only by the body's surface. Likewise, it allows that a veridical

[6]One challenge to this claim that I will be setting aside concerns so-called veridical hallucinations, in which one hallucinates a particular at such-and-such a location with such-and-such properties when, by some fortuitous accident, there just so happens to be a particular at such-and-such a location with such-and-such properties—perhaps even a particular that caused the hallucination through some deviant path [Lewis 1980]. Following Burge [2010a: 381–3], I will assume that such hallucinations are not, in fact, veridical since the perceiver is not related to the particular in the appropriate way for genuine reference to occur. But those who disagree could replace my use of the term 'veridical' (here and throughout) with 'successful', since all parties should agree that so-called veridical hallucinations are failures of a certain sort (they're hallucinations, after all).

representational state can be perceptual even if there is a significant lag between the time at which a distal stimulus sets in motion a chain of events that terminates in the proximal stimulus impinging on one's sense organs and the time at which the proximal stimulus actually impinges on one's sense organs.

Because of the necessity operator, S-D Simple also allows that some veridical occurrences of cognitive states can, as a matter of contingent fact, be sustained by present proximal stimulation. You could wear an electromagnetic helmet that stimulates your scalp, causing your neurons to align in a way that implants the true belief in you that the population of Omaha, Nebraska is 434,353, but only so long as the helmet stays on. While proximal stimulation causally sustains your belief, it isn't *necessary* to sustain a belief with this content. There is a possible world where you are not wearing the helmet or undergoing any other proximal stimulation and yet still truthfully believe that the population of Omaha is 434,353. By contrast, if S-D Simple is correct, every possible world in which you have a veridical visual perception as of a red body in front of you is a world in which your visual perception is sustained by proximal stimulation.

There are various sorts of worries that one might have about S-D Simple, but two in particular stand out. First, because it only quantifies over veridical perceptions, S-D Simple doesn't explain why non-veridical perceptions such as illusions and hallucinations should count as perceptions (if they should). Second, demonstrative thoughts are intuitively cognitive, but S-D Simple might seem to classify them as perceptual.

One possible reaction to these worries is simply to accept them as features of the view. Especially if one is prepared to recognize multiple perception–cognition boundaries, there is no obvious urgency for a boundary drawn in terms of stimulus-dependence to capture all of our intuitions. But, at the same time, if there is a natural way of using stimulus-dependence to draw the boundary that *does* handle these trouble cases in an intuitively satisfactory manner, that would surely count in its favour. Moreover, if we are, as I take us to be, at an early stage of analysis where we don't yet know for certain which other ways of drawing the boundary, if any, will prove to be theoretically useful, it would be nice to know whether an analysis that privileges stimulus-dependence is even capable of handling non-veridical perceptions and demonstrative thoughts. In the next two sections, I'll argue that it is. By reflecting on the natures of hallucination and demonstrative thought, and taking a more subtle approach to the way in which stimulus-dependence carves the perception–cognition border, these trouble cases can be happily accommodated.

4. Hallucination

Perceptions can fail in two ways. Perceptual *illusions* occur when a particular is perceptually represented as having an attribute that it does not have—for example, when a straight stick is represented as bent. Perceptual *hallucinations* occur when a particular is perceptually represented but there is no particular there—for example, when a stick is represented as bent, but there is no stick or anything else to be bent. Whereas illusions involve failures of *attribution*, hallucinations involve failures of *reference* [Burge 2010a: ch. 2].

Perceptual illusions do not occur in the absence of proximal stimulation; rather, they are causally sustained by proximal stimulation. The stick in water looks bent because of how water refracts the light that reaches your eye. A version of S-D Simple that simply struck out the word 'veridical' could thus accommodate perceptual illusions.

Distinguish two types of hallucinations: *exogenous hallucinations*, which are caused by deviant proximal stimuli; and *endogenous hallucinations*, which are caused by factors that are wholly internal to the perceiver. A visual hallucination of a dragon that is caused by direct stimulation of the retina is exogenous; but a qualitatively indistinguishable visual hallucination that is generated solely by the ingestion of LSD is endogenous. Exogenous hallucinations are as unproblematic as illusions, since present proximal stimulation is necessary to causally sustain them. In the case of direct stimulation of the retina, the hallucination works through proximal stimulation. Endogenous hallucinations, by contrast, are causally sustained independently of proximal stimulation. Take enough LSD and you can hallucinate the sight of a dragon with your eyes closed.[7] If they are perceptions, endogenous hallucinations are thus more problematic.

It is possible, however, to challenge the premise that endogenous hallucinations are genuine perceptions. According to Burge [2005: 42], 'Hallucinations caused by tickling the brain, or by internal pathology, are not clearly a perceptual state. They could be confused with one—as a memory could be confused with one.' Building on Burge's suggestion, we might observe that so-called endogenous hallucinations are aetiologically very different from veridical perceptions, illusory perceptions, and exogenous hallucinations. Aetiologically, such states are more similar to prototypical imaginations since they are neither initiated, nor sustained, by proximal stimulation. So, why not say that the LSD user *imagines* the dragon as being in front of her? Why not say that *all* endogenous hallucinations are just imaginations of a certain sort?[8]

Admittedly, endogenous hallucinations differ from certain imaginations in so far as they are insulated from the will. But there are plenty of imaginations that are also insulated from the will. It is doubtful, for example, that hungry people can will themselves to stop imagining food or that nicotine addicts can will themselves to stop imagining their next cigarette.

Another reason why one might take endogenous hallucinations to be perceptions is that they are phenomenally similar to, and can even be introspectively confused with, perceptions. Yet as Burge notes, perceptions can also be phenomenally similar to, and introspectively confused with, memories. Likewise, the Perky effect [Perky 1910; Segal 1972] suggests that perceptions can be confused with imaginations.[9] The difficulty that we sometimes have in introspectively distinguishing endogenous hallucinations from perceptions thus fails to show that endogenous hallucinations *are* perceptions.

These considerations show that there is more conceptual space than one might have supposed there to be in which to argue that endogenous hallucinations are not perceptions. Ultimately, however, there is reason to doubt that this conclusion is correct, at least when interpreted as a universal claim about *all* endogenous hallucinations. This reason comes into focus when we shift our attention away from endogenous hallucinations with extraordinary origins (the ingestion of LSD, tickling the brain, etc.) and towards endogenous hallucinations with more pedestrian roots.

[7] Or at least if you take enough Philosophers' LSD, which, I'm told, has somewhat different properties than the real stuff.

[8] A position along these lines is defended by Allen [2015] for all hallucinations (endogenous or exogenous—he doesn't distinguish). He motivates it as a way of defending disjunctivism.

[9] Perky asked subjects to visually imagine an object (e.g. a banana) while staring at a white screen. Unbeknownst to the subjects, an image of the object was then faintly projected onto the screen. The subjects reported images that were clearly influenced by the projection (e.g. in orientation), although the subjects remained unaware of the projection.

Anyone who has undergone a hearing test at the doctor's office will know that it can be extremely challenging to determine whether a tone has been presented (a signal trial) or not (a noise trial). Perceptual psychologists explain this phenomenon, in part, by supposing that perceptual processing is subject to endogenously produced random noise. The perceived signal is always a combined function of this random noise and the external signal. When the strength of the external signal is low, relative to the amount of noise, the perceptual system has difficulty in reliably dissociating the two. As a result, there are inevitably some false positives where a (phantom) signal is perceived even though the contribution from proximal stimulation is nil. Such false positives are endogenous hallucinations: the endogenously produced noise gives rise to the perception as of a signal all on its own. Perceptual psychology treats such false positives as belonging to the same general kind as veridical perceptions of a signal. Both are simply spikes in sensory activity. This generates theoretical pressure to count such false positives as perceptions, and thus to acknowledge the existence of endogenous hallucinatory perceptions. Unlike the influence of LSD or brain tickling, the influence of noise is uncontroversially a part of the ordinary workings of the perceptual system. It would thus take a revisionary hand to wave away such false positives as non-perceptual.

There is, in any case, a very natural way to accommodate endogenous hallucinatory perceptions without straying too far from S-D Simple. Instead of holding that perceptual states are distinguished from cognitive states by virtue of *being* stimulus-dependent, we can instead maintain that perceptual states are distinguished from cognitive states by virtue of having the *aim*, or *function*, of being stimulus-dependent. We can thus exchange S-D Simple for this:

> S-D Function: Ψ is perceptual if, necessarily, all occurrences of Ψ have the function of being stimulus-dependent; otherwise, Ψ is cognitive.

Something that has a function is evaluable according to a norm for fulfilling the function. For example, a heart has the function of pumping blood, and is thus evaluable according to how well it fulfils this function. A heart that stops pumping blood doesn't cease to be a heart; it just ceases to be a good heart. It fails in its function. Likewise, beliefs plausibly have the function of being true even though many are false. Truth is their aim, but that aim isn't always realized. If perceptual states have the function of being stimulus-dependent, they could thus fail in that function and still be perceptual. The false positives that result during noise trials are, plausibly, perceptual for this reason. They have the function of being stimulus-dependent; they just fail in that function. S-D Function thus allows us to capture what seemed right about S-D Simple, while extending the analysis to accommodate non-veridical perceptions.

Although I take the function of being stimulus-dependent to distinguish perceptual from cognitive states, I do not deny that perceptual states have other functions. Like beliefs, they surely also have the function of representing veridically. Maybe they have further functions, too.

Some things derive their functions from the functions of the mechanisms that produce them. Millikan [1984: ch. 2] calls such functions 'derived functions'.[10] To borrow one of her examples, the chameleon's camouflage mechanism has the (non-derived) function of

[10]There are other elements of Millikan's account that I reject. In particular, Millikan [2004: 67–8] maintains that all functions must be effects. I agree that functions are often effects. Blood circulation is an effect of the heart. Stimulus-dependent mental states are effects of perceptual mechanisms. But I deny that all functions are effects. Beliefs have the function of representing truly, but truth is not an effect of belief (except in unusual cases). Nor is being stimulus-dependent an effect of perceptual states.

producing skin colours that match the chameleon's current background. The colour on the chameleon's skin on a given occasion then has the derived function of matching the chameleon's current background, although it can fail in that function. Similarly (this is my example now), a machine in a factory that has the function of producing refrigerator magnets will endow its outputs with the function of being magnetic, although the outputs might fail in their function, either because the machine malfunctions or because something goes wrong post-production (for example, the magnet is subjected to extreme heat). I take it that perceptual states, analogously, have the derived function of being stimulus-dependent because they are produced by brain mechanisms that have the function of generating stimulus-dependent outputs.[11]

If we are going to count endogenous hallucinations as perceptions when they have the function of being stimulus-dependent, it would be nice to know, if only in broad outline, how we can tell whether a given hallucination has that function. For example, suppose that a stimulus-independent mental state represents a red body in front of the perceiver when there is no body there. Has the subject non-veridically perceived the body and thus suffered an endogenous hallucinatory perception? Or has the subject instead suffered an endogenous hallucinatory imagination? If the answer depends on whether the hallucination of the red body was produced by a mechanism that has the function of generating stimulus-dependent outputs, then we'll want to know how functions are to be assigned to mechanisms.

One way to answer this challenge would be to provide a reductive analysis of functions—say, in terms of natural selection [ibid.; Neander 1991] or the contribution that a component makes to a larger system [Cummins 1975]. We could then determine whether a given hallucination has the function of being stimulus-dependent by applying our reductive analysis of functions to the mechanism that produced that hallucination. But there is another route available. Even in the absence of a reductive analysis of functions, it is often possible to confidently assign functions to mechanisms and, thereby, to the states that they produce. In fact, our rational credence in assigning functions to mechanisms seems to me to often surpass our rational credence in accepting any particular reductive theory of functions. We are, I believe, more justified in believing that the visual system has the function of seeing and that the heart has the function of pumping blood than we are in accepting any particular analysis of what the facts are in virtue of which the visual system and the heart have those functions. Thus, if we have reason to believe that a mechanism has the function of producing stimulus-dependent outputs, and we also have reason to believe that a mental state is the product of that mechanism, we will have reason to count that mental state as perceptual rather than as cognitive. This is why we are justified in treating false positives that arise during noise trials as perceptual: they are generated by the auditory system, which has the function of producing stimulus-dependent mental states.

To get a better idea of how we can assign functions to hallucinations without the help of a reductive analysis of functions, consider a further concrete example: people with schizophrenia who hear voices that aren't really there. Should we say that they *perceptually* hallucinate voices? Or should we say that they *imaginatively* hallucinate voices? The answer, I've been suggesting, depends on the mechanism that generates

[11]Note that perceptual states and the brain mechanisms that produce them have related, but not identical, functions. (Only the mechanism has the function of producing mental states.) An analogous point holds in the chameleon and magnet examples.

those voices. If the mechanism has the function of producing states that are stimulus-dependent, then we should count the voices as hallucinatory perceptions. But if the voices are generated by a mechanism that lacks that function, we may instead have reason to count them as imaginations. Suppose, for example, that we had evidence that schizophrenic hallucinations were produced by portions of the auditory cortex that are otherwise associated with veridical speech perception. That would provide reason to think that those hallucinations were produced by a mechanism that has the function of being stimulus-dependent, and should thus be classified as hallucinatory perceptions. If, by contrast, we had evidence that they were produced by portions of the cortex that are otherwise associated with outer and inner speech production, we would have reason to think that they should be classified as hallucinatory imaginations. Now, as it happens, there is evidence that the voices that schizophrenics hear are often generated by Broca's area, a portion of the frontal cortex that is responsible for outer and inner speech production [McGuire et al. 1993; Kühn and Gallinat 2010]. So, there is reason to count them as hallucinatory imaginations rather than as hallucinatory perceptions.

Other hallucinations are more plausibly counted as perceptions. The false positives that arise during noise trials are one example. Likewise, many forms of tinnitus, the ringing in one's ears that often grows more pronounced with age, are associated with activity in the auditory pathways [Kaltenbach 2000; Lanting et al. 2009], suggesting that they have the function of being stimulus-dependent and thus count as hallucinatory perceptions. The complex and sometimes cartoon-like visual hallucinations of Charles Bonnet Syndrome also plausibly have the function of being stimulus-dependent since they are correlated with activity in areas of the visual cortex that are more closely linked to mechanisms of visual perception than to mechanisms of visual imagination [ffytche et al. 1998]. Of course, the point at present is not to definitively classify hallucinations of this or that type, but instead to show how, in principle, empirical evidence can help to determine whether a given hallucination has the function of being stimulus-dependent, and thus to gain a feeling for how S-D Function can be used to sort perceptual from cognitive states even in some difficult cases.

5. Demonstrative Thought

Some demonstrative thoughts are *perceptually grounded*: the thinker's current perceptions help to determine their contents. If you're looking at your crowded bookshelf while focusing your visual attention on a copy of *The Brothers Karamazov* and you think *That book is large*, your thought will be about the copy of *The Brothers Karamazov* on your shelf. Other demonstrative thoughts are *mnemonically grounded*: the thinker's current memories help to determine their contents. If, after visually attending to a copy of *The Brothers Karamazov*, you close your eyes, recall a visual image of the book, and think *That book is large*, your thought will likewise be about the copy of *The Brothers Karamazov* from your shelf.

Because they do not rely on current perception, there is no temptation to view mnemonically grounded demonstrative thoughts (MGDTs) as having the function of being stimulus-dependent. They need not be causally sustained by present proximal stimulation in order to be veridical. Perceptually grounded demonstrative thoughts (PGDTs), by contrast, do plausibly have the function of being stimulus-dependent. You cannot veridically sustain the visually grounded demonstrative thought, *That book is large*, if

you close your eyes. Yet demonstrative thoughts are paradigmatically cognitive, making PGDTs *prima facie* counterexamples to S-D FUNCTION.

For certain purposes, it may make sense to count PGDTs as perceptual rather than as cognitive. After all, PGDTs really do piggyback on perception in a way that other thoughts—including other demonstrative thoughts—do not. But there are also contexts where it is helpful to distinguish perception from PGDT. Researchers who deny that perceptions are cognitively penetrable do not typically deny that PGDTs are cognitively penetrable. If I believe that my grandmother has red hair, as a result I may very well think *That woman has red hair,* even when I visually attend only to her feet. Likewise, those who deny that perceptions can justify beliefs or that perceptions have rich contents do not typically deny that PGDTs can justify beliefs or have rich contents. So, we should not in general elide the distinction between perception and PGDT.

There is, moreover, reason to think that PGDTs differ from perceptions *with respect to their stimulus-dependence*. To a first approximation, that difference is this: whereas veridical perceptions are *fully* stimulus-dependent, veridical PGDTs are only *partially* stimulus-dependent. To bring this difference into focus, it will help to say something about how perceptions and demonstrative thoughts are each structured.

Following Burge [2010a], I will assume that perceptions and demonstrative thoughts are each composed of a demonstrative element (*That*) which refers to a particular, and attributive elements (*F, G, H, …*) which indicate properties, relations, and kinds. Thus, according to Burge, a perceptual state might have the structure *That F G H* and a demonstrative thought might have the structure *That F is G and H*.[12] Burge calls the attributive elements in perception *perceptual attributives*, and the attributive elements in demonstrative thought *conceptual attributives*.

The demonstrative elements that feature in veridical perceptions and PGDTs are clearly both stimulus-dependent. Their very referents are contextually determined by a causal link to a distal stimulus that flows through proximal stimulation. Present proximal stimulation thus sustains the veridical application of both kinds of demonstrative elements. In order to veridically visually perceive a copy of *The Brothers Karamazov*, or to refer to it through the demonstrative element of a veridical visually grounded demonstrative thought, your eyes must be open. With respect to the stimulus-dependence of their demonstrative elements, perceptions and demonstrative thoughts are thus on a par.

Perceptions and demonstrative thoughts differ, however, with respect to the stimulus-dependence of their attributive elements. Consider perceptual attributives first. For any given perceptual attributive, there exist indefinitely many patterns of proximal stimulation that are compatible with its veridical application (*compatible patterns*), but also indefinitely many patterns of proximal stimulation that are incompatible with its veridical application (*incompatible patterns*). If I know only that you will veridically visually perceive something as spotted (or red, or circular, …), I will not be able to predict with any great precision how your retina will be stimulated. But my knowledge does constrain the possibilities. I can rule out the indefinitely many incompatible patterns. The veridical application of a perceptual attributive is thus *proximally*

[12]The difference in structure is meant to mark perception as being non-propositional. Because perceptual attributives cannot be divorced from a contextually specified particular, there is no 'pure' predication in perception, which Burge [2010a: 537–47, 2010b] takes to be necessary for propositional structure. But, for our purposes, it's the commonalities that matter. Both states contain demonstrative and attributive elements.

constrained—that is, constrained by present proximal stimulation. One cannot sustain the veridical application of a perceptual attributive in the absence of (one of indefinitely many compatible patterns of) proximal stimulation, suggesting that perceptual attributives have the function of being stimulus-dependent.

Conceptual attributives, by contrast, do not have the function of being stimulus-dependent. This is clearest in the case of MGDTs, since these as a whole lack that function. But the only difference between MGDTs and PGDTs is that the latter are perceptually, rather than mnemonically, grounded: perception rather than memory helps to determine their contents. And there are two reasons to doubt that PGDTs are perceptually grounded in virtue of their conceptual attributives.

First, if the conceptual attributives in PGDTs were perceptually grounded, they should be proximally constrained in the way that perceptual attributives are. But they're not. Imagine watching a spotted sandpiper fly across the sky. At first, the sandpiper is close enough that you can see the distinctive pattern of dark spots on its breast. At this point, you can veridically attribute spottedness to the bird in both perception and PGDT. As it flies further away, however, the sandpiper eventually reaches a point where you can still see it, but can no longer make out its spots perceptually. Yet, using a PGDT, you can still veridically think, *That bird is spotted*. That is, you can still veridically attribute spottedness in PGDT.

Second, if the conceptual attributives in PGDTs were perceptually grounded, they should be limited to representing perceptible attributes. But they seem to be bounded only by one's conceptual repertoire. For example, I take it to be as uncontroversial as things get in this corner of the philosophy of perception that one cannot perceive the property of being an instance of an existential masterpiece. Yet one can surely entertain (while visually attending to a copy of *The Brothers Karamazov*) the PGDT, *That book is an instance of an existential masterpiece*.

We started this section with the idea that some demonstrative thoughts are perceptually grounded—present perception helps to determine their contents. We can now appreciate that this is true in a limited way. The demonstrative elements in PGDTs have their referents determined by perception, but the attributive elements float free from perception. PGDTs thus have the function of being stimulus-dependent, but solely in virtue of their demonstrative elements.

These considerations show that PGDTs undermine S-D Function. But they also point the way to revision:

> S-D Full: Ψ is perceptual if, necessarily, all occurrences of all elements of Ψ have the function of being stimulus-dependent; otherwise, Ψ is cognitive.

In the occurrence of a perceptual state, the demonstrative and attributive elements both have the function of being causally sustained by present proximal stimulation. Perceptual states thus have the function of being *fully* stimulus-dependent. Cognitive states, by contrast, have the function of being at most *partially* stimulus-dependent. For example, in the occurrence of a PGDT, only the demonstrative elements have the function of being stimulus-dependent; the conceptual attributives do not.

The appeal to S-D Full helps us to classify PGDTs as cognitive, but one might worry that this help comes at a cost. Consider a perceptual representation of a three-dimensional object, such as an apple. The perceptual representation will include not only attributives such as *red* that characterize its visible surface, but also attributives that characterize its three-dimensional shape and volume. Yet three-dimensional shape and

volume have no direct correlates in proximal stimulation (at least in certain circumstances). The retinal activation caused by a whole apple is (in certain circumstances) identical to the retinal activation caused by a two-dimensional apple facade. And so one might infer that perceptual attributives for three-dimensional properties cannot have the function of being stimulus-dependent.

But this line of reasoning betrays a misunderstanding of the relevant notion of stimulus-dependence. To be stimulus-dependent in the relevant sense, an attributive must be causally sustained by *some present proximal stimulation or other*. There is no further requirement that the proximal stimulation bear a 'direct' correspondence to the content of the attributives that it sustains. Thus, the fact that perceptual attributives can indicate three-dimensional properties is not a relevant consideration. All that matters is whether the attributives have the function of being sustained by some present proximal stimulation or other. Perceptual attributives have that function even when they indicate three-dimensional properties; conceptual attributives do not.

There is another worry that one might have about S-D Full. It might seem that some conceptual attributives have the function of being stimulus-dependent. Consider your PGDT, *That flower has that colour*, entertained as you visually attend to a red flower.[13] It is a familiar fact that we lack standing concepts for all of the colours that we can perceive. Thus, it is plausible that your ability to veridically refer to the flower's specific shade of red piggybacks on your concurrent perception, and (hence) on proximal stimulation. So, one might conclude that the attributive in your PGDT has the function of being stimulus-dependent, in which case it might seem that S-D Full counts your PGDT as perceptual.

But this objection overlooks the fact that the PGDT, *That flower has that colour,* includes two demonstrative–attributive pairs: *That flower* and *that colour*. Each pair consists of a demonstrative element (*that*), which does have the function of being stimulus-dependent, and a conceptual attributive (*flower/colour*), which does not. Thus, while the demonstrative–attributive pair *that colour* has the function of being stimulus-dependent, it has that function solely in virtue of its demonstrative element (*that*). The attributive element (*colour*) does not have that function, and thus the thought as a whole does not have the function of being *fully* stimulus-dependent.

What *would* be a problem for S-D Full is a PGDT that contained no attributives—a pure *That is that* thought. It is doubtful, however, that such thoughts are genuinely possible. Looking at a red flower, you might entertain any one of a number of demonstrative thoughts: *That flower is that colour; That object is that size; That colour is at that place;* etc. But what would it mean to entertain a thought with the content *That is that*, if not to entertain one of these other more specific thoughts? Without an attributive to guide it, the application of a demonstrative element would have no way to acquire a definitive content. Of course, you could utter the *words* 'That is that.' But any proposition expressed by those words would need to include attributive as well as demonstrative elements.

While I have motivated S-D Full by drawing on Burge's views about the structure of perception and demonstrative thought, there are other frameworks that could serve the same purpose. The crucial point that any framework would need to respect is that there are elements in perception that have the function of being stimulus-dependent, but

[13]Thanks to Brad Thompson for the example.

whose analogues in PGDT do not. Many theorists who reject Burge's framework are able to respect this point since they join him in holding that perceptual contents contain attributive elements; they just reject Burge's demonstrative elements in favour of object-involving elements, gappy elements, or existentially quantified variables. Such theorists can thus maintain that perceptual attributives, but not conceptual attributives, have the function of being stimulus-dependent. This is not to say, however, that every framework is a natural fit for S-D FULL. Frameworks that reject structured contents altogether, such as the possible-worlds framework, have nothing to play the role that attributive elements play in Burge's account—at least not at the level of content. Yet even the possible-worlds framework could be rendered compatible with S-D FULL by taking mental states to have structured vehicles rather than structured contents. For example, syntactically individuated elements in a language of thought could play the role that attributives play in Burge's framework. Thus, while it would be a stretch to claim that something like S-D FULL can be adopted by *any* framework in the philosophy of perception, it is compatible with more frameworks than one might have supposed.

6. Conclusion

I have taken some initial steps towards drawing a perception–cognition boundary in terms of stimulus-dependence. One step was focused on the sustaining role that present proximal stimulation plays in perception. Necessarily, veridical perceptual states are causally sustained by present proximal stimulation. A second step sought to accommodate non-veridical perceptual states by appealing to their functions. Perceptual states, whether veridical or not, necessarily have the function of being stimulus-dependent. One corollary of this second step was that hallucinations bifurcate into two varieties—imaginative and perceptual. Perceptual hallucinations have the function of being stimulus-dependent, but imaginative hallucinations do not. A final step sought to distinguish perceptual states from demonstrative thoughts. Demonstrative thoughts are not always perceptually grounded (they can be mnemonically grounded instead); but, even when they are, I argued, they have only one foot grounded in perception. Thus, whereas all elements of perceptual states have the function of being stimulus-dependent, PGDTs are cognitive because they have some elements that lack that function.[14]

Funding

While writing this paper, I was supported by a fellowship from the American Council of Learned Societies.

[14]Thanks to audiences at the Top-Down Influences Workshop at the University of Glasgow, the York University Centre for Vision Research, the Southern Society for Philosophy and Psychology meeting in New Orleans (where Zoe Jenkin commented), the American Philosophical Association Central Division meeting in Saint Louis (where Brad Thompson commented), the Society for Philosophy and Psychology meeting in Vancouver, the Perception and Concepts Symposium at the University of Latvia, and the Department of Philosophy at Carleton University. For helpful comments and/or conversations, I'm also grateful to Derek Brown, Tyler Burge, Brian Huss, Marta Jorba, Muhammad Ali Khalidi, Peter Langland-Hassan, Fiona Macpherson, Susanna Siegel, Kritika Yegnashankaran, and two anonymous referees.

References

Allen, K. 2015. Hallucination and Imagination, *Australasian Journal of Philosophy* 93/2: 287–302.

Beck, J. 2012. The Generality Constraint and the Structure of Thought, *Mind* 121/483: 563–600.

Beck, J. 2015. Analogue Magnitude Representations: A Philosophical Introduction, *The British Journal for the Philosophy of Science* 66/4: 829–55.

Briscoe, R.E. 2016. Multisensory Processing and Perceptual Consciousness: Part I, *Philosophy Compass* 11/2: 121–33.

Briscoe, R.E. forthcoming. Multisensory Processing and Perceptual Consciousness: Part II, *Philosophy Compass*.

Burge, T. 2005. Disjunctivism and Perceptual Psychology, *Philosophical Topics* 33/1: 1–78.

Burge, T. 2010a. *Origins of Objectivity*, Oxford: Clarendon Press.

Burge, T. 2010b. Steps toward Origins of Propositional Thought, *Disputatio* 4/29: 39–67.

Burge, T. 2014. Reply to Block: Adaptation and the Upper Border of Perception, *Philosophy and Phenomenological Research* 89/3: 573–83.

Camp, E. 2009. Putting Thoughts to Work: Concepts, Systematicity, and Stimulus-Independence, *Philosophy and Phenomenological Research* 78/2: 275–311.

Carey, S. 2009. *The Origin of Concepts*, New York: Oxford University Press.

Clark, A. 2013. Whatever Next? Predictive Brains, Situated Agents, and the Future of Cognitive Science, *Behavioral and Brain Sciences* 36/3: 181–204.

Cosmides, L. 1989. The Logic of Social Exchange: Has Natural Selection Shaped How Humans Reason? Studies with the Wason Selection Task, *Cognition* 31/3: 187–276.

Cummins, R. 1975. Functional Analysis, *The Journal of Philosophy* 72/20: 741–65.

ffytche, D.H., R.J. Howard, M.J. Brammer, A. David, P. Woodruff, and S. Williams 1998. The Anatomy of Conscious Vision: An fMRI Study of Visual Hallucinations, *Nature Neuroscience* 1/8: 738–42.

Firestone, C. and B.J. Scholl 2016. Cognition Does Not Affect Perception: Evaluating the Evidence for 'Top-Down' Effects, *Behavioral and Brain Sciences* 39: 1–19.

Gallistel, C.R. 1990. *The Organization of Learning*, Cambridge, MA: The MIT Press.

Hansen, T., M. Olkkonen, S. Walter, and K.R. Gegenfurtner 2006. Memory Modulates Color Appearance, *Nature Neuroscience* 9/11: 1367–8.

Hermer, L. and E.S. Spelke 1994. A Geometric Process for Spatial Reorientation in Young Children, *Nature* 370/6484: 57–9.

Kaltenbach, J.A. 2000. Neurophysiologic Mechanisms of Tinnitus, *Journal of the American Academy of Audiology* 11/3: 125–37.

Kosslyn, S.M., W.L. Thompson, and G. Ganis 2006. *The Case for Mental Imagery*, Oxford: Oxford University Press.

Kühn, S. and J. Gallinat 2010. Quantitative Meta-Analysis on State and Trait Aspects of Auditory Verbal Hallucinations in Schizophrenia, *Schizophrenia Bulletin* 38/4: 779–86.

Lanting, C.P., E. de Kleine, and P. van Dijk 2009. Neural Activity Underlying Tinnitus Generation: Results from PET and fMRI, *Hearing Research* 255/1–2: 1–13.

Lewis, D. 1980. Veridical Hallucination and Prosthetic Vision, *Australasian Journal of Philosophy* 58/3: 239–49.

Locke, J. 1689 (1975). *An Essay Concerning Human Understanding*, ed. P.H. Nidditch, Oxford: Clarendon Press.

Lupyan, G. 2015. Reply to Macpherson: Further Illustrations of the Cognitive Penetrability of Perception, *Review of Philosophy and Psychology* 6/4: 585–9.

Mandelbaum, E. 2013. Numerical Architecture, *Topics in Cognitive Science* 5/2: 367–86.

McGuire, P.K., G.M. Shah, and R.M. Murray 1993. Increased Blood Flow in Broca's Area During Auditory Hallucinations in Schizophrenia, *Lancet* 342/8873: 703–6.

Millikan, R.G. 1984. *Language, Thought and Other Biological Categories: New Foundations for Realism*, Cambridge, MA: The MIT Press.

Millikan, R.G. 2004. *Varieties of Meaning: The 2002 Jean Nicod Lectures*, Cambridge, MA: The MIT Press.

Nanay, B. 2015. Perceptual Content and the Content of Mental Imagery, *Philosophical Studies* 172/7: 1723–36.

Nanay, B. 2016. Imagination and Perception, in *The Routledge Handbook of Philosophy of Imagination*, ed. A. Kind, Abingdon, UK: Routledge: 124–34.

Neander, K. 1991. Functions as Selected Effects: The Conceptual Analyst's Defense, *Philosophy of Science* 58/2: 168–84.
O'Callaghan, C. 2015. Not All Perceptual Experience is Modality Specific, in *Perception and Its Modalities*, ed. D. Stokes, M. Matthen, and S. Biggs, New York: Oxford University Press: 133–65.
Perky, C.W. 1910. An Experimental Study of Imagination, *American Journal of Psychology* 21/3: 422–52.
Phillips, B. manuscript. The Shifting Border between Perception and Cognition.
Prinz, J.J. 2006. Is Emotion a Form of Perception? *Canadian Journal of Philosophy* 36/S1: 137–60.
Segal, S.J. 1972. Assimilation of a Stimulus in the Construction of an Image: The Perky Effect Revisited, in *The Function and Nature of Imagery*, ed. W.P. Sheehan, New York: Academic Press: 203–30.
Shea, N. 2015. Distinguishing Top-Down From Bottom-Up Effects, in *Perception and Its Modalities*, ed. D. Stokes, M. Matthen, and S. Biggs, New York: Oxford University Press: 73–91.
Zeimbekis, J. 2013. Color and Cognitive Penetrability, *Philosophical Studies* 165/1: 167–75.