WILEY

Border Disputes: Recent Debates along the Perception–Cognition Border

Sam Clarke[1,2] | Jacob Beck[3]

[1]MindCore, University of Pennsylvania, Philadelphia, Pennsylvania, USA

[2]Department of Philosophy, University of Southern California, Los Angeles, California, USA

[3]Department of Philosophy & Centre for Vision Research, York University, Toronto, Ontario, Canada

Correspondence
Jacob Beck.
Email: jbeck@yorku.ca

Abstract

The distinction between perception and cognition frames countless debates in philosophy and cognitive science. But what, if anything, does this distinction actually amount to? In this introductory article, we summarize recent work on this question. We first briefly consider the possibility that a perception-cognition border should be *eliminated* from our scientific ontology, and then introduce and critically examine five positive approaches to marking a perception–cognition border, framed in terms of *phenomenology, revisability, modularity, format,* and *stimulus-dependence*.

1 | INTRODUCTION

The distinction between perception and cognition is part of common-sense. It is reflected in our leisure-time activities (as when birdwatchers *imagine* kakapos, but only dream of *seeing* one), our institutions (as when jurors distinguish *eyewitness* testimony from a prosecutor's *speculations*), and myriad practical matters (as when doctors *hear* a cough and *infer* the presence of COVID). But the distinction is also central to debates in philosophy and cognitive science—for example, about whether causation can be perceived, whether believing that something is a banana makes it look more yellow, and whether folk psychological categories provide a legitimate starting point for cognitive science.

Much attention has thus been paid to how we might informatively characterize the perception–cognition border. In what follows, we take readers on a whistle-stop tour of recent developments in this burgeoning literature (for a complementary review, see Nes et al., 2023). Each section considers a prominent approach to characterizing the border. We begin with *eliminativism*, which rejects the existence of a border outright, before considering five positive proposals that seek to characterize a perception-cognition border in terms of *phenomenology, revisability, modularity,*

Both authors contributed equally to this article.

----

format, and *stimulus-dependence*, respectively. Each positive proposal can be seen to offer a standalone characterization of the distinction between perception and cognition. However, it is an interesting question how these accounts relate. *Purists* will hold that one proposal takes priority over the others. *Impurists* will maintain that multiple proposals must be combined to mark the one true border. *Pluralists* will insist that several proposals are viable, and conclude that there are multiple independent, yet equally legitimate, perception–cognition borders (Phillips, 2019).

There are various ways of carving up the territory. But one important division concerns whether an approach begins with perception or thought. *Perception-first* approaches are concerned with how perception (seeing, hearing, etc.) differs from everything post-perceptual, including not just thought, but also sensory memory and sensory imagination (e.g., recalling what your kitchen looks like, or visualizing what it would look like with new countertops). *Thought-first* approaches, by contrast, prioritize the ways in which thoughts, beliefs, or other propositional attitudes differ from perception, and may be less interested in where things like memory or imagination fit into the picture.

2 | ELIMINATIVISM

While most of this article will be spent critically examining positive accounts of the perception-cognition border, it is worth emphasising that the existence of some such border is no foregone conclusion. *Eliminativists* maintain that the intuitive distinction between perception and cognition is nothing more than a confused relic of pre-scientific theorising (Clark, 2013; Lupyan, 2016; Shea, 2014).

One motivation for eliminativism concerns borderline phenomena that resist straightforward classification as perceptual or cognitive, such as the input-driven attribution of high-level contents such as kinds, location, number, agency, and causation (Shea, 2014). How to classify these phenomena remains a matter of controversy (Abid, 2022; Block, 2023; Carey, 2009; Siegel & Byrne, 2017). A second motivation for eliminativism derives from specific theories of the human mind, such as predictive processing, which posit pervasive interactions between cognition and perception. This is sometimes taken to eliminate any genuine distinction between the two, by revealing that these psychological categories are inextricably intertwined and impossible to neatly dissociate (Clark, 2013; Friston, 2010; Lupyan, 2016).

Of course, the theories motivating these claims are themselves controversial (Orlandi & Lee, 2018; Sun & Firestone, 2020). Moreover, the extent to which they bear on accounts of the perception-cognition border is not straightforward. As we will see, many accounts of the perception-cognition border are agnostic about how cognition and perception interact. In addition, Macpherson (2017) notes that it is often unclear whether the interactions these theories describe obtain between cognitive and perceptual states *of the subject*, or merely among "sub-doxastic information-carrying states of the brain that the subject does not in principle have access to" (11). For Macpherson, interactions of the latter sort are fully consistent with there being no interactions of the former variety. In any case, it is worth stressing that some indeterminacy, or messiness, at or near a perception-cognition border is to be expected on all accounts. This is because few real-world distinctions are perfectly sharp. Canada is distinct from the United States, though whether this or that pebble along the border belongs to one country or the other may admit of no principled answer.

With these complications in view, the strongest motivation for eliminativism is likely to be the perceived failure of other approaches. To assess eliminativism, we must thus assess other approaches.

3 | PHENOMENOLOGY

The phenomenal character of a mental state concerns what it is like to be in that state. At least in paradigm cases, what it is like to perceive is quite different from what it is like to cognize. No one would confuse seeing seven apples with thinking of seven apples. Could we thereby distinguish perception from cognition on phenomenological grounds?

For those taking a perception-first approach, Hume's (1739/2000) distinction between impressions and ideas is a natural source for inspiration. Thus, one might maintain that while perception has a strong and lively phenomenal character, imagination, memory, and other aspects of cognition have a fainter, more subdued phenomenal character. But this approach faces a challenge: perceptual experiences can themselves be very faint, and it's questionable whether the faintest perceptual experiences are fainter than the most vivid memories or imaginations. This objection gains support from empirical evidence that perception is confused with imagination (Perky, 1910; Segal, 1972; Allen, 2015, pp. 293-294; Nanay, 2012) and memory (Firestone & Scholl, 2015), and that they recruit similar neural regions (Kosslyn et al., 2006; Dijkstra et al., 2019; Pearson, 2019; but see Cavedon-Taylor, 2021).

For those taking a thought-first approach, an initial question is whether occurrent thought has a distinctive phenomenal character—that is, whether there is "cognitive phenomenology" (Bayne and Montague, 2011). If not, then it's trivial to distinguish the phenomenal character of thought from the phenomenal character of perception. Alternatively, if there is something it's like to think, the task becomes harder since one needs to say *how* cognitive phenomenology differs from perceptual phenomenology. Kriegel (2019) despairs that this may be impossible, so (reluctantly) embraces primitivism about the distinction; there *is* a difference in phenomenal character between perception and cognition, but it's not possible to informatively characterize that difference. Montague (2023) is also skeptical of informatively characterizing the distinction, but for a different reason. She claims that tokening a concept has a distinctive phenomenal character, but maintains that concepts are tokened in high-level perception, not just thought. She thus claims that thought can be phenomenally distinguished only from low-level perception, which she calls "sense," and not perception as such.

One concern with drawing the perception–cognition border in terms of phenomenology is that philosophers and scientists often hold that perception can be *unconscious* (Burge, 2010a; Block, 2016a; but see Phillips, 2018). Even those who disagree should admit that perception science is usually focused less on consciousness than on information processing. For understanding perception science, an appeal to a non-phenomenological perception–cognition border might therefore be more illuminating. Even so, phenomenology could still serve as *a* helpful criterion for certain purposes; most obviously, studying consciousness itself.

4 | REVISABILITY

It is a familiar fact, noticed by Descartes (1641/2017, *Meditation III*) and Berkeley (1710/1982, Part I §§28-29), that perception is insulated from the will. If you're visually attending to a red traffic light, you will almost certainly perceive the light as red—even if you would like it to be green. Hence, you cannot will yourself to perceive things in the way that you will yourself to think or imagine things. We might therefore distinguish perception from cognition by appealing to the will.

Beliefs present a challenge to this suggestion since they, too, seem insulated from the will (Williams, 1973). If offered $100 to stand on your desk, you could do so and earn the money. But if offered $100 to *believe* you are standing on your desk, you would struggle to do so—at least not without first standing on your desk.

Taking a thought-first approach, Helton (2018, 2020) replies that while beliefs are not under voluntary control, they are *revisable*, which distinguishes them from percepts. When you have strong counterevidence against your belief that *p*, you have the psychological ability—the cognitive skills required—to stop believing that *p*. In defense of this claim, Helton appeals to two premises: (1) The Norm of Revision: if you have strong evidence that *not-p*, then you ought to revise your belief that *p*; and (2) Epistemic Ought Implies Psychological Can: if you ought to revise your belief, then you have the cognitive skills required to do so.

In defense of Epistemic Ought Implies Psychological Can, Helton draws a distinction between two ways in which belief revision can fail. First, a strong desire, false belief, or other mental state can interfere with revision. For example, your belief that 8 × 6 = 46 might block you from revising your mistaken belief about how much you owe the waiter. According to Helton, you still have an obligation to revise your belief in such a case, but you also have the cognitive

skills to do so. A little reflection can bring you to see that 8 × 6 ≠ 46. Second, belief revision can fail because you lack the relevant skills. For example, there is arguably a sense in which one ought to believe everything that is logically entailed by one's beliefs, but no one can do that. Here, Helton says that there is no real epistemic obligation. No one is obligated to believe everything that is entailed by one's beliefs because no one has that cognitive skill. Epistemic obligations are constrained by cognitive skills.

A challenge to this suggestion arises when we consider people who are systematically *bad* reasoners. Take someone who systematically affirms the consequent; they lack the cognitive skills needed to reason properly. Helton should conclude that they lack an epistemic obligation to avoid affirming the consequent. But that seems questionable. Plausibly, they have an epistemic obligation to acquire new reasoning skills. (This is arguably one reason why many philosophy departments have logic requirements.) But then, it is questionable whether one's epistemic obligations are really constrained by one's cognitive skills. *Prima facie*, you can have an obligation to revise your beliefs even if you currently lack the cognitive skills required to do so (*pace* Epistemic Ought Implies Psychological Can).

This doesn't challenge Helton's main thesis that beliefs are revisable; it merely challenges a premise in her argument for that conclusion. But it might also be questioned whether revisability can ground a distinction between perception and cognition in general. That's because even if *beliefs* are revisable, there are *other cognitive states* that are plausibly un-revisable.

Helton acknowledges this (2020, p. 502). She allows that some pretenses, suppositions, and entertained thoughts may not be revisable in the above sense. The aim of her 2020 article is simply to offer a (partial) characterization of belief, not cognition in general. But in other work, Helton (2018) argues that we literally *see* the intentions of others in part because certain mental representations of intention are un-revisable (cf. Gergely & Csibra, 2003; Westfall, forthcoming). There she reasons by elimination: these states cannot be beliefs because they are un-revisable; they can't be suppositions, pretenses, or entertained thoughts for independent reasons; thus, they are perceptions. However, it might be thought that various other cognitive states are post-perceptual yet un-revisable in relevant ways. For instance, various theorists posit post-perceptual systems of "core cognition" (Carey, 2009; Spelke, 2000) and "minimal mindreading" (Apperly & Butterfill, 2009), which facilitate relevant forms of mental state ascription, despite being inferentially isolated from thought in ways that revisability would preclude (but see Herschbach, 2015). Still, revisability might remain a strong contender for distinguishing *belief* from perception.

5 | MODULARITY

Consider the Müller-Lyer illusion (Figure 1). The top line looks longer than the bottom line even though both are identical in length. Moreover, *believing* that the lines are identical in length does not change how they appear. The perceptual machinery responsible for your experience would, thus, seem impervious to your beliefs in some important respect. This motivates the idea that perception is *modular*; that perceptual mechanisms operate independently of, and without access to, cognition in some important and distinctive respect (Fodor, 1983; Pylyshyn, 1999). Might perception then be distinguished from cognition by virtue of its modularity?

One concern with this suggestion is that perception might not be as computationally insulated from cognition as the Müller-Lyer illusion suggests (Arstila, 2017; Block, 2016b; Macpherson, 2012; Ogilvie & Carruthers, 2016; Prinz, 2007; Ransom, 2020; Stokes, 2021; Wu, 2017). For instance, it has long been argued that beliefs about an object's canonical color can change its perceptual appearance, causing an orange heart to appear redder than it otherwise would (Delk & Fillenbaum, 1965) or a gray banana to appear yellow (Hansen et al., 2006), with others claiming that visual imagery alters perceptual processing in similarly subtle ways (Pearson et al., 2008; Perky, 1910). On these grounds, many argue that perception is "cognitively penetrated" despite the recalcitrance of illusions like the Muller-Lyer.

One complication is that these empirical claims are hotly contested (Gross et al., 2014; Stokes, 2013; Valenti & Firestone, 2019), and the philosophical consequences depend on how they are resolved. If there is no cognitive
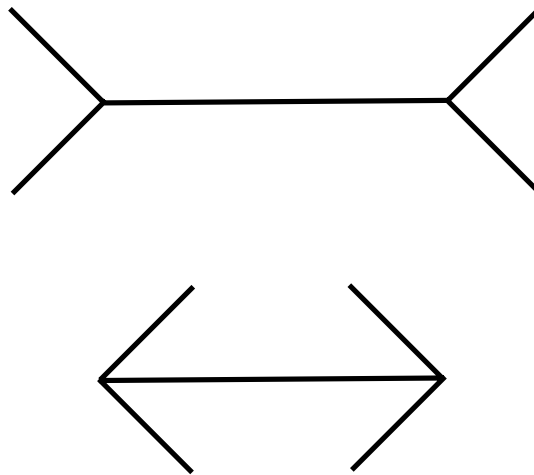
FIGURE 1   To most observers, the top line looks longer than the bottom line.

penetration whatsoever (Firestone & Scholl, 2016), this concern gains no traction. Conversely, if cognitive penetration is as rampant as some claim (Lupyan, 2016), modularity views are arguably in trouble (but see Macpherson, 2017). But if—as many now think—cognitive penetration exists but is limited in scope (Block, 2023), the consequences are less straightforward.

For instance, Green (2020) defends an "architectural division" between perception and cognition that recognizes "strict constraints on information flow" from perception to cognition (p. 323). He nevertheless maintains that cognitive penetration occurs. To this end, he is impressed by "precuing effects" in which cues to anticipate or attend to a given dimension, such as color or motion, alter how it is perceptually processed. For Green, these precuing effects suggest that cognitive states *modulate*, and thereby penetrate, perceptual processing, influencing the values it ends up representing.

At the same time, Green denies that cognition is capable of *enriching* perception by enabling it to compute over new dimensions entirely. Thus, while one can learn to distinguish Manzano bananas from Cavendish, Lady Finger, and other bananas, doing so would not enable one's visual system to represent and compute over a new visual dimension. In learning to recognize Manzano bananas, one alters the cognitive categories used to interpret the outputs of vision; but one does not alter the dimensions represented within vision itself. Thus, Green advances the *Dimension Restriction Hypothesis* (DRH): perception is distinguished from cognition because perceptual processes are incapable of enrichment. They are "architecturally constrained to compute over a bounded class of dimensions" (p. 330). Cognition might modulate the intensity of a perceptual dimension (e.g., by making bananas look yellower), but it cannot enrich perception with new dimensions (e.g., add the perceptual category *Manzano banana*).

By distinguishing modulation from enrichment, DRH promises to save some notion of modularity while accommodating certain types of cognitive penetration. But DRH won't make everyone happy. Most obviously, some will object that cognitive penetration *does* enrich perceptual content (Begby, 2017; Churchland, 1988; Kuhn, 1962; Siegel, 2010). Others will complain that DRH fails to explain the phenomena that have traditionally motivated modularists. For example, since DRH allows for modulation effects, it doesn't explain why our beliefs about the lengths of the Müller-Lyer lines *don't* modulate how they appear. While this may not refute the idea that DRH provides an extensionally adequate characterization of the perception–cognition border, it casts doubt on the suggestion that DRH carves that border at its most fundamental joint.

With this in view, some modularists seek to accommodate cognitive penetration in other ways. For example, Quilty-Dunn (2020c) observes that precuing effects often involve modulation by cognitively driven attention.[1] But he argues that attentionally modulated cognitive penetration does not, and could not, violate the modularity of

perceptual systems. That's because Quilty-Dunn takes the heart of modularity to concern a proprietary information store. Perception is modular insofar as it relies solely on its own information store when interpreting its inputs. And while attention prioritizes and modulates perceptual processing, it doesn't provide perception with access to new information. For example, attention doesn't allow one's beliefs to enter into perceptual processing. The way in which attention allows cognition to penetrate perception thus does not count as a violation of modularity.

Clarke (2021) develops a congenial suggestion. He notes that for perception to be modular there need not be one big perceptual module. Instead, perception might comprise a hierarchy of modules (Fodor, 1983, p. 46; Quilty-Dunn, 2020c, p. 344). Thus, early visual modules might offer a preliminary analysis of light on the retina, such that the outputs of this analysis can then be taken as input by higher level modules tasked with identifying increasingly abstract information (Marr, 1982). But, as Clarke observes, all of this is compatible with cognition influencing perception at the joints between modules in the hierarchy. For provided that each module processes its inputs entirely based on information stored in its own private store, every perceptual system would remain fully encapsulated from information outside of that store. On Clarke's view, cognitive penetration which occurs in this manner is thus fully compatible with the view that perception is modular through-and-through.

Clarke proceeds to argue that plausible cases of cognitive penetration may even evince a picture of this sort. He considers alleged cases of cognitive penetration involving interactions between mental imagery and vision. Various theorists consider these among the clearest violations of perceptual modularity (Block, 2016b; Ogilvie & Carruthers, 2016; Prinz, 2007). But Clarke objects that the empirical findings cited in this connection support the idea that mental imagery interacts with higher-level perceptual processes on *a visual buffer* (Kosslyn, 1980) – a functional space situated at the joint between *independently posited* modules – leaving the full-blown encapsulation of these modules intact. In fact, Clarke observes that the encapsulation of these modules could explain *why* penetration occurs on the visual buffer and not elsewhere. Since these modules are encapsulated, there is simply nowhere else for visual images to alter the perceptual process.

Confronted with alleged instances of cognitive penetration, Green, Quilty-Dunn, and Clarke all try to save perceptual modularity by, in effect, showing that a version of the view is compatible with more types of cognitive influence than one might expect. However, this leads to a potential worry when it comes to marking the perception–cognition border—a problem that is closely related to one discussed in the previous section: namely, that paradigmatic cognitive systems may now count as modular too; for instance, systems involved in mental arithmetic (Burnston & Cohen, 2015), navigation (Cheng, 1986), minimal mindreading (Apperly & Butterfill, 2009), and core cognition (Carey, 2009). Core number systems, for example, give rise to recalcitrant numerical illusions, suggesting that they are encapsulated from thought (Mandelbaum, 2013). Furthermore, they are constrained to process numerical information (Clarke & Beck, 2021), indicating that they are dimensionally restricted in the sense deemed distinctive of perception by DRH. But while these systems often appear to operate perceptually (Burr & Ross, 2008), they are sometimes implicated offline in paradigmatic cognitive activities, such as mental arithmetic (Chochon et al., 1999; Simon et al., 2002). This puts pressure on pure perception-first modularity-based accounts of the perception–cognition border, though some champions of modularity are open to impure versions of the account that add additional constraints (Green, 2020, pp. 382–383).

6 | FORMAT

Modularity is not the only way that theorists have sought to mark a perception–cognition border by appealing to proposed differences in information processing. An alternative approach appeals to differences in the *format* of the representations involved. Roughly: cognition is sentence-like, discursive, digital, conceptual, or propositional, while perception is pictorial, iconic, analog, non-conceptual, or non-propositional.

This format-based approach is compatible with other approaches to marking a perception–cognition border. For instance, Burnston (2017) proposes that differences in format imply some form of perceptual modularity (see also Butterfill, 2007). However, proponents of a format-based border are often motivated by a perceived failure of
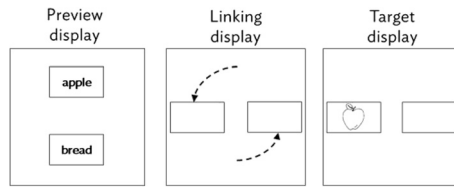
FIGURE 2 Schematic diagram of a study from Gordon and Irwin (2000). Reprinted here from Quilty-Dunn (2020b) with permission.

other approaches. For instance, Burge takes a format-based approach to characterising the border, holding that while perception is encapsulated/modular, the suggestion that this marks a perception–cognition border is "clearly incorrect" since "There are modular processes that are not perceptual" (2010, p. 249, n. 90). Conversely, Block (2016b, 2023) appeals to differences of format to mark the border in part due to a perceived lack of encapsulation in perception.

Block (2023, Ch. 4) argues that perception is non-propositional and non-conceptual because it lacks logical form. For example, there is no negation or disjunction in perception—you cannot perceive that your handkerchief is *not* red, or that it is *either* red *or* blue. Block (2023, Ch. 5) argues that perception is iconic, or analog, by marshalling evidence that mental imagery is iconic and then arguing that mental imagery and perception involve representations of the same kind. On Block's view, these format differences distinguish perception from cognition: whereas perception is constitutively non-propositional, non-conceptual, and iconic, cognition is paradigmatically (though not constitutively) propositional, conceptual, and discursive. Here, Block's approach is plausibly best interpreted as thought-first since it allows that perception and mental imagery have the same format. Perception and various representations from core cognition, such as approximate number representations (Carey, 2009; Beck, 2019; cf. Clarke, 2022a), might also be taken to have the same format, though Block (2023, Ch. 12) resists the suggestion.

Of course, the appeal to format is itself controversial. For some this is because perception lacks a distinctive format, and trades in discursive representations of the sort employed in thought (Pylyshyn, 2003). Alternatively, some claim that cognitive representations are all inherently sensory (Prinz, 2003). But many others accept the existence of mental representations with a variety of format types yet deny that they track the border between perception and cognition (Beck, 2012, 2019; Fodor, 2007, 2008; Mandelbaum, 2018; Quilty-Dunn, 2016, 2020b).

To this end, some deny that perception is entirely iconic or pictorial. For example, Quilty-Dunn (2016, 2020b) appeals to evidence that, while some visual representations have a pictorial format, high-level concepts (like CAT and BREAD) can also get perceptually bound to object representations in what are called "object files" (Kahnemann et al., 1992). In support of this claim, he appeals to *object reviewing studies*. In one such study by Gordon and Irwin (2000) (Figure 2), subjects saw objects labeled with the words 'apple' and 'bread' on a screen. These labels subsequently disappear, and the objects begin moving. After some period, they stop and a picture appears in one of the objects, which sometimes matches one of the original labels (e.g., a picture of an apple) and sometimes does not (e.g., a picture of a cat). Subjects are asked whether the picture matches either of the original labels. Interestingly: while subjects tend to be highly accurate, they are significantly quicker to respond when the picture is presented on the object that contained its matching label (e.g., the picture of an apple on the object that contained the label 'apple') than when the picture is presented on the other object (e.g., the picture of an apple on the object that contained the label 'bread'). This suggests that abstract information (e.g., the kind *apple*) is somehow bound to the original object across perceived changes in its position. Quilty-Dunn infers that the objects must be perceptually represented in a non-pictorial, conceptual format, since a pictorial representation couldn't represent abstract kinds like *apple* without holistically binding them to a particular appearance. Thus, Quilty-Dunn concludes that perception cannot be demarcated by its pictorial format.

There are several lines of reply open to proponents of the format view. First, they might endorse Quilty-Dunn's characterization of object files but deny that they are perceptual (e.g., Spelke, 1988; Block, 2023, Ch. 5; though see Quilty-Dunn, 2020b, pp. 822–829; Green, 2023). Alternatively, they might reply that object files are neither

determinately perceptual nor determinately cognitive (Taylor, 2018). Or they might reply that Quilty-Dunn has been too quick to think that perception needs to represent like a realistic picture in order to have a distinctive format.

To develop this last reply, one might look to Burge (2010a, 2010b), who argues that perception is non-propositional because, unlike thought, it lacks genuine predication. Instead, perception has the structure of a complex demonstrative, like the phrase 'That $F_1...F_n$'. For example, a visual percept might be partly characterized by the content *That red spherical body*. Perception thus includes attributives (e.g., *red*, *spherical*, *body*) even though it is non-propositional. This opens up the possibility that abstract attributives like *apple* could feature in perception and help to explain the object-specific preview benefit.

Clarke (2022b) develops another way to resist the assumption that perception needs to be pictorial to have a unique format. Following Treisman (1986), he argues that the icons of early vision function more like maps than pictures. On his view, perceptual representations are spatially structured (like a picture) but features like color and shape are encoded independently of one another in distinct feature maps, and do not 'gloop' together as they would in a photograph. Clarke concludes as much because he thinks that the postulation of feature maps explains otherwise puzzling results, and does a better job of explaining the results which have traditionally motivated theorists to posit pictorial representations in early vision. But while Clarke argues that the maps found in early vision lack conceptual constituents entirely, he notes that perception would remain cartographic through and through even if conceptual elements were sometimes bound to the spatially located object representations Quilty-Dunn describes. On this view, complex perceptual representations always have a cartographic, spatial structure, even if they sometimes comprise conceptual constituents (see also Burge, 2010a, 2018).

Mandelbaum (2018) offers an alternative argument for the claim that high-level categorization occurs in early visual processing and takes this to undermine a format-based border while simultaneously supporting the existence of a border framed in terms of modularity. He appeals to evidence suggesting that we can reliably categorize images (e.g., as of a *swan* or *bear catching fish*) incredibly fast. For instance, Potter et al. (2014) demonstrated that images presented for just 13 ms could be reliably categorized in this way. Since top-down influences would take much longer than 13 ms, Mandelbaum concludes that conceptual categorization must occur within the visual system itself, in a bottom-up manner, and without help from higher cognition.

But while images in Potter et al.'s (2014) study were presented for just 13 ms, response times were much longer, and could have included time for cognition to categorize a perceptual representation. Mandelbaum replies that response times are themselves quite fast—around 120 ms in some studies, which is "too fast for feedback loops from cognition to help decode the stimuli" (Mandelbaum, 2018, p. 275). But it is unclear why feedback loops are needed. Perception could output representations of shapes, say, that automatically trigger the tokening of certain concepts in cognition by default. In fact, the studies Mandelbaum describes provide reason to think that perception is representing and *retaining* detailed low-level properties of the images, as might be captured in a picture, such that this could then be passed on to cognition for categorization. For in trials in which the target category was actually present, subjects were subsequently shown two images containing the target category and asked to identify which of these was the target image they had originally categorized. Since subjects who correctly reported seeing an instance of the target category in the original image performed comparably well in this task, it seems that they were retaining fine-grained information about the visual image even after categorization had taken place and that they were able to use this fine-grained information to reidentify the image they had originally categorized. This is consistent with the idea that such categorization occurred post-perceptually, and was based on perceptual images of the stimuli, retained in memory after the fact, not some intra-perceptual conceptualization process. (For further critical discussion of Mandelbaum's argument, see Block, 2023, Ch. 8.)

7 | STIMULUS-DEPENDENCE

Perception is *sensory*. It involves the use of the senses (vision, audition, etc.), which extract information about the external world from proximal stimulation (light, sound, etc.). By contrast, cognition can run offline, without the

operation of the senses and in the absence of proximal stimulation. Thus, you cannot see Times Square with your eyes closed, though you can think about or imagine it just fine. This has led some philosophers to defend purist (Beck, 2018) or impurist (Phillips, 2019) versions of the perception-first proposal that perception should be distinguished from cognition in virtue of its *stimulus-dependence*.

There is a sense in which the modularity and format approaches both propose that the perception–cognition border is *deep*. It is captured by a non-obvious property that lies beneath the surface, discoverable only through considerable scientific investigation. But some scientifically useful distinctions are shallow. Scientists find it helpful to distinguish carnivores from herbivores, deciduous from evergreen plants, and tropical from temperate rainforests. These distinctions are characterized by relatively superficial properties. Likewise, the criterion of stimulus-dependence marks the perception–cognition boundary in a relatively shallow way. It is just the distinction between those mental entities that depend on proximal stimulation (in the relevant way), and those that do not.

According to Beck (2018), a mental state is stimulus-dependent just in case it is causally sustained by present proximal stimulation. Thus, seeing is stimulus-dependent because it is causally sustained by light on your retina. If light is blocked from reaching your retina (e.g., because you close your eyes) you can no longer see. By contrast, beliefs, memories, imaginings, and other cognitive states are stimulus-independent because proximal stimulation is not necessary to sustain them. You can believe, remember, or imagine that Times Square is in front of you with your eyes closed.

Quilty-Dunn (2020a) objects that if we follow Beck (2018), perception will be nonconceptual by fiat. For if perception needs to be fully stimulus-dependent, then concepts like *swan* could not be tokened within the visual system before being sent to thought. And Quilty-Dunn thinks it's an empirical matter whether concepts are tokened in perception (à la Mandelbaum). Advocates of stimulus-dependence might reply that just as proponents of modularity often deny the possibility of cognitive penetration, they can deny that concepts are tokened in perception. Both are developing analyses that they take to be recommended by the empirical evidence. Where they disagree about what that evidence shows, their analyses will differ—by design, not fiat.

Another way to address Quilty-Dunn's objection is suggested by O'Callaghan & Beck, (in prep.). They take perception and cognition to be distinct faculties, where each faculty is a collection of capacities (O'Callaghan, 2021; Schellenberg, 2018). A capacity belongs to perception if it can be exercised in a stimulus-dependent manner and to cognition if it can be exercised in a stimulus-independent manner. Because some capacities can be exercised in each manner, the two faculties are non-exclusive; they partially overlap. This account allows that a given conceptual capacity might be exercised perceptually on some occasions and cognitively on others, evading Quilty-Dunn's worry.

Sometimes perceptual capacities are exercised unsuccessfully, resulting in hallucinations or after-images. Hallucinations and after-images are plausibly perceptual despite not being stimulus-dependent. But proponents of stimulus-dependence can distinguish perceptual capacities from cognitive capacities because their *successful* exercise is causally dependent on present proximal stimulation. Mental states that result from the exercise of perceptual capacities can then be counted as perceptual whether they are stimulus-dependent or not (Beck, 2018; see also Schellenberg, 2018). By comparison, a basketball shot counts as such even if it misses the hoop.

Setting aside hallucinations, Cermeño-Aínsa (2021) objects that the stimulus-dependence view struggles to accommodate two other phenomena: visual categorization and amodal completion. Suppose you see a woman in the distance who you recognize to be your mother. That act of visual categorization plausibly involves the tokening of concepts, like *my mother*, in a way that is stimulus-independent. You can continue to think that the woman is your mother even if you close your eyes. But the act of visual categorization is also plausibly perceptual, at least in part. One way to handle this would be to allow that visual categorization is neither purely perceptual nor purely cognitive. Rather, it's a hybrid phenomenon.

Now suppose your mother is half occluded by a wall when you see her, so that only the right side of her body is visible. You nevertheless visually represent her left half as continuing behind the wall. The stimulus-dependence view counts amodal completion as perceptual because proximal stimulation is necessary to sustain it: if you didn't see the right side of your mother, you wouldn't be able to "complete" the left side of her. But Cermeño-Aínsa (2021) argues

that this sort of amodal completion relies on your background beliefs about what your mother looks like, suggesting that it is partly cognitive. The stimulus-dependence view, however, can allow that cognition influences perception, and thus that your beliefs about your mother influence your perception of your mother. A mental state that includes amodal completion can be perceptual even if it is influenced by cognition.

Burge (2022) raises a quite different concern: he objects that the stimulus-dependence approach counts some forms of short-term visual memory as cognitive, including visual sensory memory (which retains considerable visual information for up to half a second) and trans-saccadic memory (which maintains stability during quick eye movements of 30-50 ms), a result he calls "clearly unacceptable" (p. 673; but see Block, 2023, p. 263). Burge's diagnosis is that perception and cognition are non-exhaustive categories; these forms of memory are neither perceptual nor cognitive.

Proponents of stimulus-dependence might reply by expanding the temporal window of stimulus-dependence, though the challenge would be to do this in a way that isn't *ad-hoc*. Alternatively, they might take stimulus-dependence to mark the border between perception and extra-perception and then either rest satisfied with a very broad view of cognition or else take cognition to consist in stimulus-independence plus some additional criterion (thereby conceding to Burge that sensory and trans-saccadic memory belong to neither perception nor cognition). Which of these strategies is best, and whether they can be successfully developed, remains to be seen.

8 | CONCLUSION

Our discussion has been selective. After noting that the existence of a perception-cognition border is no foregone conclusion, we critically examined five prominent approaches to marking the border—in terms of phenomenology, revisability, modularity, format, and stimulus-dependence. Each approach has been challenged, and many issues remain open. Beyond asking whether any one approach is workable, researchers might explore Impurist approaches to the perception-cognition border, asking if or how multiple approaches can be combined to provide an extensionally adequate characterization. Relatedly, they might ask whether there is a single perception–cognition border to mark, or whether Pluralism is required (Phillips, 2019). This is worth considering since those who start from perception and ask how everything post-perceptual differs (i.e., take a *Perception-First Approach*) are likely to arrive at importantly different analyses than those who start from belief (say) and ask how it differs from perception (or take a *Thought-First Approach*, more generally). Finally, it is worth considering if or how the perceived failure of the approaches we have considered supports eliminativism about the border. This is important to consider, since eliminativists have tended to find inspiration in the perceived failure of just one or two possible accounts (e.g., a perceived failure to draw the border in terms of phenomenology or modularity – Clark, 2013; Lupyan, 2016). If there is one take home message from our discussion, it is that there are many possible approaches to drawing a fruitful perception-cognition border.

ORCID
Jacob Beck https://orcid.org/0000-0002-2991-3124

ENDNOTE
[1] Other times, precuing effects might work via expectations alone, without attention (cf. Green, 2020, pp. 377–381 and Quilty-Dunn, 2020c, p. 340, n. 5).

REFERENCES

Abid, G. (2022). Recognition and the perception–cognition divide. *Mind and Language*, 37(5), 770–789. https://doi.org/10.1111/mila.12362

Allen, K. (2015). Hallucination And Imagination. *Australasian Journal of Philosophy*, 93(2), 287–302. https://doi.org/10.1080/00048402.2014.984312

Apperly, I. A., & Butterfill, S. A. (2009). Do humans have two systems to track beliefs and belief-like states? *Psychological Review*, 116(4), 953–970. https://doi.org/10.1037/a0016923

Arstila, V. (2017). Cognitive penetration, hypnosis and imagination. *Analysis*, 77(1), 3–10. https://doi.org/10.1093/analys/anx048

Bayne, T. & Montague, M. (Eds.). (2011). *Cognitive Phenomenology*. Oxford University Press UK.

Beck, J. (2012). The Generality Constraint and the Structure of Thought. *Mind*, 121(483), 563–600. https://doi.org/10.1093/mind/fzs077

Beck, J. (2018). Marking the Perception–Cognition Boundary: The Criterion of Stimulus-Dependence. *Australasian Journal of Philosophy*, 96(2), 319–334. https://doi.org/10.1080/00048402.2017.1329329

Beck, J. (2019). Perception is Analog: The Argument from Weber's Law. *Journal of Philosophy*, 116(6), 319–349. https://doi.org/10.5840/jphil2019116621

Begby, E. (2017). Perceptual expansion under cognitive guidance: Lessons from language processing. *Mind and Language*, 32(5), 564–578. https://doi.org/10.1111/mila.12159

Berkeley, G. (1710/1982). *A Treatise Concerning the Principles of Human Knowledge*. In K. Winkler (Ed.). Hackett.

Block, N. (2016a). The Anna Karenina principle and skepticism about unconscious perception. *Philosophy and Phenomenological Research*, 93(2), 452–459. https://doi.org/10.1111/phpr.12258

Block, N. (2016b). Tweaking the concepts of perception and cognition. *Behavioral and Brain Sciences*, 39, e232. https://doi.org/10.1017/s0140525x15002733

Block, N. (2023). *The Border Between Seeing and Thinking*. Oxford University Press.

Burge, T. (2010a). *Origins of Objectivity*. Oxford University Press.

Burge, T. (2010b). Steps toward origins of propositional thought. *Disputatio*, 4(29), 39–67. https://doi.org/10.2478/disp-2010-0010

Burge, T. (2018). Iconic Representation: Maps, Pictures, and Perception. In W. Shyam & F. Antonio Dorio (Eds.), *The Map and the Territory: Exploring the Foundations of Science, Thought and Reality* (pp. 79–100). Springer.

Burge, T. (2022). *Perception: First Form of Mind*. Oxford University Press.

Burnston, D. C., & Cohen, J. (2015). Perceptual Integration, Modularity, and Cognitive Penetration. In A. Raftopoulos & J. Zeimbekis (Eds.), *Cognitive Influences on Perception: Implications for Philosophy of Mind, Epistemology, and Philosophy of Action*. Oxford University Press.

Burnston, D. C. (2017). Cognitive penetration and the cognition–perception interface. *Synthese*, 194(9), 3645–3668. https://doi.org/10.1007/s11229-016-1116-y

Burr, D., & Ross, J. (2008). A visual sense of number. *Current Biology*, 18(6), 425–428. https://doi.org/10.1016/j.cub.2008.02.052

Butterfill, S. A. (2007). What are modules and what is their role in development? *Mind and Language*, 22(4), 450–473. https://doi.org/10.1111/j.1468-0017.2007.00316.x

Carey, S. (2009). *The origin of concepts*. Oxford University Press.

Cavedon-Taylor, D. (2021). Untying the knot: imagination, perception and their neural substrates. *Synthese*, 199(3–4), 7203–7230. https://doi.org/10.1007/s11229-021-03110-x

Cermeño-Aínsa, S. (2021). Is Perception Stimulus-Dependent? *Review of Philosophy and Psychology*, 13(3), 1–20. https://doi.org/10.1007/s13164-021-00558-1

Cheng, K. (1986). A purely geometric module in the rat's spatial representation. *Cognition*, 23(2), 149–178. https://doi.org/10.1016/0010-0277(86)90041-7

Chochon, F., Cohen, L., van de Moortele, P. F., & Dehaene, S. (1999). Differential contributions of the left and right inferior parietal lobules to number processing. *Journal of Cognitive Neuroscience*, 11(6), 617–630. https://doi.org/10.1162/089892999563689

Churchland, P. M. (1988). Perceptual plasticity and theoretical neutrality: A reply to Jerry Fodor. *Philosophy of Science*, 55(June), 167–187. https://doi.org/10.1086/289425

Clark, A. (2013). Whatever next? Predictive brains, situated agents, and the future of cognitive science. *Behavioral and Brain Sciences*, 36(3), 181–204. https://doi.org/10.1017/s0140525x12000477

Clarke, S. (2021). Cognitive penetration and informational encapsulation: Have we been failing the module? *Philosophical Studies*, 178(8), 2599–2620. https://doi.org/10.1007/s11098-020-01565-1

Clarke, S. (2022a). Beyond the icon: Core cognition and the bounds of perception. *Mind and Language*, 37(1), 94–113. https://doi.org/10.1111/mila.12315

Clarke, S. (2022b). Mapping the Visual Icon. *The Philosophical Quarterly*, 72(3), 552–577. https://doi.org/10.1093/pq/pqab054

Clarke, S., & Beck, J. (2021). The number sense represents (rational) numbers. *Behavioral and Brain Sciences*, *44*, 1–57. https://doi.org/10.1017/s0140525x21000571

Delk, J. L., & Fillenbaum, S. (1965). Differences in perceived colour as a function of characteristic color. *The American Journal of Psychology*, *78*(2), 290–293. https://doi.org/10.2307/1420503

Descartes, R. (1641/2017). *Meditations on First Philosophy* (J. Cottingham, Trans.). Cambridge University Press.

Dijkstra, N., Bosch, S. E., & van Gerven, M. A. J. (2019). Shared neural mechanisms of visual perception and imagery. *Trends in Cognitive Sciences*, *43*(5), 423–434. https://doi.org/10.1016/j.tics.2019.02.004

Firestone, C., & Scholl, B. J. (2015). Enhanced visual awareness for morality and pajamas? Perception vs. memory in 'top-down' effects. *Cognition*, *136*, v409–v416. https://doi.org/10.1016/j.cognition.2014.10.014

Firestone, C., & Scholl, B. J. (2016). Cognition does not affect perception: Evaluating the evidence for "top-down" effects. *Behavioral and Brain Sciences*, *39*, 1–72. https://doi.org/10.1017/s0140525x15000965

Fodor, J. A. (1983). *The Modularity of Mind: An Essay on Faculty Psychology*. MIT Press.

Fodor, J. A. (2007). The revenge of the given. In B. P. McLaughlin & J. D. Cohen (Eds.), *Contemporary Debates in Philosophy of Mind* (pp. 105–116). Blackwell.

Fodor, J. A. (2008). *Lot 2: The Language of Thought Revisited*. Oxford University Press.

Friston, K. (2010). The free-energy principle: A unified brain theory? *Nature Reviews Neuroscience*, *11*(2), 127–138. https://doi.org/10.1038/nrn2787

Gergely, G., & Csibra, G. (2003). Teleological reasoning in infancy: the naïve theory of rational action. *Trends in Cognitive Sciences*, *7*(7), 287–292. https://doi.org/10.1016/s1364-6613(03)00128-1

Gordon, R. D., & Irwin, D. E. (2000). The role of physical and conceptual properties in preserving object continuity. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *26*(1), 136–150. https://doi.org/10.1037/0278-7393.26.1.136

Green, E. J. (2020). The Perception–Cognition Border: A Case for Architectural Division. *Philosophical Review*, *129*(3), 323–393. https://doi.org/10.1215/00318108-8311221

Green, E. J. (2023). The Perception–Cognition Border: Architecture or Format? In B. P. McLaughlin & J. D. Cohen (Eds.), *Contemporary Debates in Philosophy of Mind* (2nd ed., pp. 469–493).

Gross, S., Chaisilprungraung, T., Kaplan, E., Menendez, J. A., & Flombaum, J. I. (2014). Problems for the purported cognitive penetration of perceptual color experience and Macpherson's proposed mechanism. *Baltic International Yearbook of Cognition, Logic and Communication*, *9*(1), 6. https://doi.org/10.4148/1944-3676.1085

Hansen, T., Olkkonen, M., Walter, S., & Gegenfurtner, K. R. (2006). Memory modulates color appearance. *Nature Neuroscience*, *9*(11), 1367–1368. https://doi.org/10.1038/nn1794

Helton, G. (2018). Visually Perceiving the Intentions of Others. *The Philosophical Quarterly*, *68*(271), 243–264. https://doi.org/10.1093/pq/pqx051

Helton, G. (2020). If You Can't Change What You Believe, You Don't Believe It. *Noûs*, *54*(3), 501–526. https://doi.org/10.1111/nous.12265

Herschbach, M. (2015). Direct social perception and dual process theories of mindreading. *Consciousness and Cognition*, *36*, 483–497. https://doi.org/10.1016/j.concog.2015.04.001

Hume, D. (1739/2000). *A Treatise of Human Nature*. Oxford University Press.

Kahneman, D., Treisman, A., & Gibbs, B. J. (1992). The reviewing of object files: Object-specific inte-gration of information. *Cognitive Psychology*, *24*(2), 175–219. https://doi.org/10.1016/0010-0285(92)90007-o

Kosslyn, S. (1980). *Image and Mind*. Harvard University Press.

Kosslyn, S., Thompson, W. L., & Ganis, G. (2006). *The Case for Mental Imagery*. Oxford University Press.

Kriegel, U. (2019). Phenomenal Intentionality and the Perception/Cognition Divide. In A. Sullivan (Ed.), *Sensations, Thoughts, Language: Essays in Honor of Brian Loar* (pp. 167–183). Routledge.

Kuhn, T. S. (1962). *The Structure of Scientific Revolutions*. University of Chicago Press.

Lupyan, G. (2016). Cognitive Penetrability of Perception in the Age of Prediction: Predictive Systems are Penetrable Systems. *Review of Philosophy and Psychology*, *6*(4), 547–569. https://doi.org/10.1007/s13164-015-0253-4

Macpherson, F. (2012). Cognitive Penetration of Colour Experience: Rethinking the Issue in Light of an Indirect Mechanism. *Philosophy and Phenomenological Research*, *84*(1), 24–62. https://doi.org/10.1111/j.1933-1592.2010.00481.x

Macpherson, F. (2017). The relationship between cognitive penetration and predictive coding. *Consciousness and Cognition*, *47*, 6–16. https://doi.org/10.1016/j.concog.2016.04.001

Mandelbaum, E. (2013). Numerical Architecture. *Topics in Cognitive Science*, *5*(1), 367–386. https://doi.org/10.1111/tops.12014

Mandelbaum, E. (2018). Seeing and Conceptualizing: Modularity and the Shallow Contents of Perception. *Philosophy and Phenomenological Research*, *97*(2), 267–283. https://doi.org/10.1111/phpr.12368

Marr, D. (1982). *Vision*. W. H. Freeman.

Montague, M. (2023). The sense/cognition distinction. *Inquiry: An Interdisciplinary Journal of Philosophy*, *66*(2), 229–245. https://doi.org/10.1080/0020174x.2018.1562371

Nanay, B. (2012). The philosophical implications of the Perky experiments: reply to Hopkins. *Analysis*, *72*(3), 439–443. https://doi.org/10.1093/analys/ans066

Nes, A., Sundberg, K., & Watzl, S. (2023). The perception/cognition distinction. *Inquiry: An Interdisciplinary Journal of Philosophy*, *66*(2), 165–195. https://doi.org/10.1080/0020174x.2021.1926317

O'Callaghan, C. (2021). Senses as Capacities. *Multisensory Research*, *34*(3), 233–259. https://doi.org/10.1163/22134808-bja10024

O'Callaghan, C. & Beck, J. (in prep.). A capacities approach to the perception–cognition distinction.

Ogilvie, R., & Carruthers, P. (2016). Opening Up Vision: The Case Against Encapsulation. *Review of Philosophy and Psychology*, *7*(4), 721–742. https://doi.org/10.1007/s13164-015-0294-8

Orlandi, N., & Lee, G. (2018). How Radical is Predictive Processing? In M. Colombo, E. Irvine, & M. Stapleton (Eds.), *Andy Clark and his Critics*. Oxford University Press.

Pearson, J. (2019). The human imagination: The cognitive neuroscience of visual mental imagery. *Nature Reviews Neuroscience*, *20*(10), 624–634. https://doi.org/10.1038/s41583-019-0202-9

Pearson, J., Clifford, C. W. G., & Tong, F. (2008). The functional impact of mental imagery on conscious perception. *Current Biology*, *18*(13), 982–986. https://doi.org/10.1016/j.cub.2008.05.048

Perky, C. W. (1910). An Experimental Study of Imagination. *American Journal of Psychology*, *21*(3), 422–452. https://doi.org/10.2307/1413350

Phillips, B. (2019). The Shifting Border Between Perception and Cognition. *Noûs*, *53*(2), 316–346. https://doi.org/10.1111/nous.12218

Phillips, I. (2018). Unconscious Perception Reconsidered. *Analytic Philosophy*, *59*(4), 471–514. https://doi.org/10.1111/phib.12135

Potter, M., Wyble, B., Hagmann, C., & McCourt, E. (2014). Detecting meaning in RSVP at 13 ms per picture. *Attention, Perception, & Psychophysics*, *76*(2), 270–279. https://doi.org/10.3758/s13414-013-0605-z

Prinz, J. J. (2007). Is the mind really modular? In R. J. Stainton (Ed.), *Contemporary Debates in Cognitive Science* (pp. 22–36). Blackwell.

Prinz, J. J. (2003). *Furnishing the Mind: Concepts and Their Perceptual Basis*. MIT Press.

Pylyshyn, Z. (1999). Is vision continuous with cognition?: The case for cognitive impenetrability of visual perception. *Behavioral and Brain Sciences*, *22*(3), 341–365. https://doi.org/10.1017/s0140525x99002022

Pylyshyn, Z. W. (2003). Seeing and Visualizing: It's Not What You Think.

Quilty-Dunn, J. (2016). Iconicity and the Format of Perception. *Journal of Consciousness Studies*, *23*(3–4), 255–263.

Quilty-Dunn, J. (2020a). Concepts and predication from perception to cognition. *Philosophical Issues*, *30*(1), 273–292. https://doi.org/10.1111/phis.12185

Quilty-Dunn, J. (2020b). Perceptual Pluralism. *Noûs*, *54*(4), 807–838. https://doi.org/10.1111/nous.12285

Quilty-Dunn, J. (2020c). Attention and encapsulation. *Mind and Language*, *35*(3), 335–349. https://doi.org/10.1111/mila.12242

Ransom, M. (2020). Attentional Weighting in Perceptual Learning. *Journal of Consciousness Studies*, *27*(7–8), 236–248.

Schellenberg, S. (2018). *The Unity of Perception*. Oxford University Press.

Segal, S. J. (1972). Assimilation of a Stimulus in the Construction of an Image: The Perky Effect Revisited. In P. Sheehan (Ed.), *The Function & Nature of Imagery* (pp. 203–230). Academic Press.

Shea, N. (2014). Distinguishing Top-Down From Bottom-Up Effects. In D. Stokes, M. Matthen, & S. Biggs (Eds.), *Perception and Its Modalities* (pp. 73–91). Oxford University Press.

Siegel, S. (2010). *The Contents of Visual Experience*. Oxford University Press.

Siegel, S., & Byrne, A. (2017). Rich or thin? In B. Nanay (Ed.), *Current Controversies in Philosophy of Perception* (pp. 59–80). Routledge.

Simon, O., Mangin, J.-F., Cohen, L., Le Bihan, D., & Dehaene, S. (2002). Topographical layout of hand, eye, calculation, and language-related areas in the human parietal lobe. *Neuron*, *33*(3), 475–487. https://doi.org/10.1016/s0896-6273(02)00575-5

Spelke, E. S. (1988). Where perceiving ends and thinking begins: The apprehension of objects in infancy. In A. Yonas (Ed.), *Perceptual development in infancy* (pp. 197–234). Lawrence Erlbaum Associates, Inc.

Spelke, E. S. (2000). Core knowledge. *American Psychologist*, *55*(11), 1233–1243. https://doi.org/10.1037/0003-066x.55.11.1233

Stokes, D. (2013). Cognitive Penetrability of Perception. *Philosophy Compass*, *8*(7), 646–663. https://doi.org/10.1111/phc3.12043

Stokes, D. (2021). *Thinking and Perceiving: On the malleability of the mind*. Routledge.

Sun, Z., & Firestone, C. (2020). The Dark Room Problem. *Trends in Cognitive Sciences*, *24*(5), 346–348. https://doi.org/10.1016/j.tics.2020.02.006

Taylor, H. (2018). Fuzziness in the Mind: Can Perception be Unconscious? *Philosophy and Phenomenological Research*, *101*(2), 383–398. https://doi.org/10.1111/phpr.12592

Treisman, A. (1986). Features and Objects in Visual Processing. *Scientific American*, *255*(5), 114b–125b. https://doi.org/10.1038/scientificamerican1186-114b

Valenti, J. J., & Firestone, C. (2019). Finding the "odd one out": Memory color effects and the logic of appearance. *Cognition*, *191*, 103934. https://doi.org/10.1016/j.cognition.2019.04.003

Westfall, M. Perceiving Agency. *Mind and Language* (forthcoming).

Williams, B. (1973). Deciding to believe. In *Problems of the Self* (pp. 136–151). Cambridge University Press.

Wu, W. (2017). Shaking Up the Mind's Ground Floor: The Cognitive Penetration of Visual Attention. *Journal of Philosophy*, *114*(1), 5–32. https://doi.org/10.5840/jphil201711411

AUTHOR BIOGRAPHIES

Sam Clarke is a MindCORE Research Fellow at the University of Pennsylvania, splitting his time between philosophy, psychology and linguistics, and from July 2023 he'll be an assistant professor of philosophy at the University of Southern California. Most of his work sits at the intersection between philosophy and cognitive science, and he is particularly interested in issues relating to perception, cognitive architecture and pre-linguistic cognition.

Jacob Beck is York Research Chair in the Philosophy of Visual Perception in the Department of Philosophy and Centre for Vision Research at York University in Toronto, Canada. Beck's research mines philosophy and the cognitive sciences to illuminate the mind. He has a special interest in the format and content of pre-linguistic forms of mental representation, such as perception and the number sense. His research has appeared in philosophy journals such as *Mind, Noûs,* and *The Journal of Philosophy*, cognitive science journals such as *Cognition* and *Behavioral and Brain Sciences*, and popular outlets such as *The Atlantic* and *Scientific American*.