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## Border crossings: Perceptual and post-perceptual object representation

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**Abstract:** Carey's claim that no object representations are perceptual rests on a faulty view of perception. To delineate origins of post-perceptual ("conceptual" or "core cognitive") representation, we need a more accurate view of perceptual representation.

In *The Origin of Concepts*, Susan Carey argues that object representations are exclusively nonperceptual (Carey 2009). I believe that this view is mistaken. There are object perceptions – what I call “perceptual attributives as of objects” – at least in the visual and tactile perceptual modalities of a wide range of animals. There are, of course, also nonperceptual object representations. Some of these might be termed “concepts.” But perceptual object representations are not concepts. Carey's fine book describes important aspects of object representation. However, there is a need to evaluate which of the phenomena that she discusses are postperceptual and which have origins already in perceptual systems.

Carey claims, “representations of object cannot be stated in the vocabulary of perception” (Carey 2009, p. 63). She cites Piaget and Quine, with approval, as predecessors in denying that object representations are perceptual. Piaget is credited with the claim that object representations are nonperceptual because they are multimodal (Carey 2009, p. 34) (Piaget, 1954). Piaget does not show that all object representations are multimodal, only that some are. (There is evidence that visual object representations do not require intermodal experience.) Visual–perceptual object representations can underlie multimodal object representations.

Carey associates Quine (Quine 1960) with this further argument:

If perceptual representations are limited to what currently experienced entities look like... objects cannot be represented as individuals that persist through time, independently of the observer... As Quine pointed out, a perceptual vocabulary does not include fundamental quantificational devices. The child could not represent a given object as the same one as one seen earlier, for sensory representations do not provide criteria for numerical identity. (Carey 2009, p. 34; see also pp. 40, 63, 94–6)

Carey adds, seemingly in her own voice:

The criteria for individuation and numerical identity for ordinary objects go beyond perceptual primitives... Although perceptual primitives can specify a currently perceived, bounded entity and its current path of motion, they do not specify that the entity continues to exist when we lose perceptual contact with it. (Carey 2009, p. 36)

It is a mistake to require of a system that has object representations that it have quantificational devices, or representations of criteria for numerical identity, or *specifications* of continuity under loss of perceptual contact (using that “vocabulary”). Nor need object *perception* represent particulars *as* persisting, or *as* independent of an observer, or *as* unperceived, in order to perceptually represent something as an object or body. A perception as of objects need not represent persistence, observers, perceptual contact, or independence from observers. Such requirements confuse principles according to which perception operates with representations that occur in perceptual object representation.

It is enough that a perceptual system operate under principles that require of the perceiver a capacity to track objects perceptually – where tracking requires coordination of perception with perceptual memory and perceptual anticipation. Therefore, Carey's remarks about quantification, criteria, and the inability of perceptions to specify continuity under loss of perceptual contact, are irrelevant to whether perceptual representations can represent entities as objects or bodies. (I discuss the points of the last two paragraphs in Burge 2010, Ch. 7, 9, and 10, especially the section “Body Representation as Originating in Perception.” There I criticize arguments of Carey's colleague, Elizabeth Spelke, that no object representations are perceptual.)

No serious empirical account of perception takes its representations to depend for their content entirely on what happens at a given moment. Interrelations between perceptual systems, perceptual memory, and perceptual anticipation are common even in the simplest perceptual systems. Exercises of perceptual shape constancy or color constancy over time require coordination of current perception with perceptual memory and perceptual anticipation. Such coordinative capacities are present in insects and other relatively simple animals that may not have object perception, and plausibly lack “concepts.” Perception of motion and change are standard topics of vision research.

*Object* or *body* perception is constitutively dependent on coordination between the perceptual system and perceptual anticipations of persistence over time; commonly in motion and commonly behind barriers. Therefore, to be a perception as of a body, a representation must be associated with a tendency to perceptually anticipate certain types of continuity. A perceptual representation can present something as looking like a body in *current* experience, as long as the “look” is associated with perceptual anticipations of certain types of continuity.

If Carey and Quine assume that perceptual representation excludes connection to perceptual anticipation and perceptual memory in the individuation of perceptual representation, they have a mistaken view of perception. Apart from this assumption, and apart from the error of requiring that the perceiver must *have* quantification, or criteria, in order to perceive something as an object or body, the quoted arguments have no force against the view that perceptual representations include object (body) perceptions.

There is substantial evidence that perceptual body representations occur in the visual systems of many mammals and some birds. Anticipations of continuities that are relevant to perceiving entities as bodies are associated with very early vision. The anticipations are not matters of conception or prediction. (Peterson 2001; Wexler & Held 2005.) Steps have been taken toward localizing the physical basis for object determination in areas of the human brain specialized for vision. (Grill-Spector et al. 2001; Kourtzi et al. 2003; Nielsen et al. 2006.) The idea that body representation does not occur in visual (or tactile) perception simply does not accord with research in perceptual psychology. Carey gives no good reason to reject this research.

A deficient view of *perception* therefore underlies Carey's account of “conceptual” object representation. It is not clear which phenomena that she discusses are postperceptual, perceptual, or both. Most of her characterizations of object “concepts” apply equally to object perceptions (Carey 2009, pp. 67–68). The key to the distinction must lie in better characterization of “central inferential processes,” including richer distinctions between the ways postperceptual and perceptual object representations relate to other processes and representations. The deficiency in drawing the perceptual/post-perceptual distinction may hamper Carey's accounts of the other representations of attributes that she discusses: representations of quantity, agency, and cause. Unquestionably, human children and higher animals do have postperceptual representations of these three attributes, as well as the attribute of objecthood. A more accurate view of perceptual representation is needed to delineate origins of postperceptual representation.

strategy was no doubt confusing, because I myself do not accept many of those previous analyses as actually drawing the relevant distinctions between conceptual and perceptual representations. For example, commentator **Burge** thinks that I am endorsing Piaget's and Quine's characterization of how perceptual representations differ from conceptual ones, but I am not. Piaget and Quine both argued that young infants created no representations of *object*, because infants are incapable of object individuation, of representing a later-encountered entity as the same object as one encountered earlier, and therefore are incapable of appreciating object permanence. I show that Piaget and Quine were wrong about the representational capacities of infants, and that therefore by their analyses, young infants have a *concept* of objects. That is, infants have object representations, where *object* means roughly *bounded, coherent, separately moving, spatiotemporally continuous material entity*. Note, this gloss reflects implicit content. Infants integrate information from different modalities, and go beyond stationary snapshots of objects, in creating such representations. But I fully agree with Burge that perceptual representations go beyond sensory ones in these ways, and that therefore these facts do not rule out that object representations in infancy are perceptual.

**Burge** also seems to think that because I take object representations to be conceptual, I am denying that there are or could be perceptual representations of objects as well. Again, I do not. Adults clearly have both. The question then becomes, as he points out, what reasons are there to believe that infants have conceptual object representations? My belief that they do hangs on the central inferential role of infants' object representations; their inferential interrelations with causal representations and agent representations, and the fact that they are input into working memory models of small sets over which many different quantitative computations are defined. The quantitative capacities in questions are not the within-module computations of object individuation and numerical identity that are relevant to arguments against Piaget and Quine. Rather, *TOOC* reviews evidence that working memory models of small sets of objects are input into processes that compute total surface area or volume (as in deciding which bucket has more cracker stuff in it) and into computations of one-one correspondence (as in deciding whether all of the objects placed into a container have been removed). Chapter 4 also reviews evidence that infants can create hierarchical models of sets (e.g., a model that is a set of two sets, each containing two objects [see Feigenson & Halberda 2004]), and Chapter 7 reviews evidence that prelinguistic infants have a mental symbol *plural* that applies to sets of objects. These are the quantitative computations that suggest central conceptual role to me. With respect to the integration of object representations with causal representations and agent representations, see Chapters 5 and 6.

Commentator **Gauker** argues that by my own characterization of concepts, icons cannot be concepts, so if the representations in core cognition are iconic, they cannot be conceptual representations. He illustrates his points in relation to the concept *object*. At issue is how we draw the distinction between conceptual representations, on the one hand, and other kinds of representations, on the other. Gauker stipulates that conceptual representations

must be part of a representational system with some sentence-like format; to have the concept *object* the child must be able to think the thought we can express in words "that is an object." (Therefore, Gauker claims that there also must be concepts of *that*, *is*, *a*, for there to be the concept *object*.) I do not agree with these claims.

By "conceptual," I do not mean "language-like." I mean what **Gauker** says I mean – expressing content not expressible in spatiotemporal or sensorimotor vocabulary, and participating in central, conceptual, inferential roles. The question is whether a symbol with the content we express by *object* can be carried by an iconic symbol, such as "🏀." Gauker takes it as obvious that such a symbol cannot represent what two objects have in common, or two balls, as the words "object" or "ball" do. Who can say that? What determines what "🏀" represents? The position taken in *TOOC* is that the answer to this question, abstractly, is the same as what determines what "object" represents – on a dual factor theory, the causal connections between the symbol and the entities in its extension, and some aspects of its computational role. Chapters 2 and 3 provide an extended argument that such a symbol (an object file) for young infants does indeed have the content *object* (i.e., it represents a particular object *as such*, in a particular location relative to the infant and relative to other objects, and Chapters 4 through 7 argue for central conceptual role: objects are represented in working memory models that support action, and in particular causal relations to other objects, and in particular intentional relations to agents. Some of this content is implicit (i.e., it is not required that the child have the ability to think the thought that one object is a different object from another), but I assume that object files are explicit symbols, most probably iconic. Chapter 7 argues that such a symbol decidedly does not have the same content as does the word "ball" until late in infancy, at the developmentally earliest. In sum, the "alternative" picture Gauker offers is a good sketch of how I think about core cognition, because I do not take "conceptual" to mean "language-like."

Commentator **Hill** also comments on object representations, and on my treatment of Quine's position in particular. Hill argues that by crediting infants with representations of *object stages*, or undetached *object parts*, Quine is already committed to their representing objects, as representations of objects are presupposed by representations of stages of objects or undetached parts of objects. I understand Quine to be imagining a representational state of affairs formulated over sensory snapshots and associations among them (and I believe there is textual evidence that something like this is what Quine had in mind for his "perceptual similarity space," Carey 1994; 2009, Ch. 2). On this exegesis of Quine's position, infants' representations of object stages does not require them to have representations of objects.

In *TOOC*, I concede one of **Hill's** points: that it would be possible, in principle, to formulate any one of the infant's expectancies (such as that revealed in the rotating screen experiment Hill takes as an example) in terms of statistical relations among such snapshots. I argue against this alternative on simplicity grounds. At issue is the classic problem of induction; what would lead the infant to focus in on the relevant statistical regularities