

On the Developmental Origins of Knowledge of Physical Objects

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Question

‘... ’tis past doubt, that Men have in their Minds several Ideas ...: It is in the first place to be enquired, How he comes by them?’ (Locke 1689, p. 104).

What is the nature of infants’ earliest cognition of physical objects? And how do you get from these early forms of cognition to knowledge of simple facts about particular physical objects?

4- and 5-month-olds can track briefly occluded objects

scenario	method	source
1 vs 2 objects	habituation	Spelke et al 1995
one unperceived object constrains another’s movement	habituation	Baillargeon 1987
where did I hide it?	violation-of-expectations	Wilcox et al 1996
wide objects can’t disappear behind a narrow occluder	violation-of-expectations	Wang et al 2004
when and where will it reappear?	anticipatory looking	Rosander et al 2004

For a process to *track* an unperceived object is for it to nonaccidentally depend in some way on the unperceived object’s path.

Core Knowledge

‘there is a third type of conceptual structure, dubbed “core knowledge” ... that differs systematically from both sensory/perceptual representation[s] ... and ... knowledge.’ (Carey 2009, p. 10)

‘core systems are largely innate, encapsulated, unchanging, arising from phylogenetically old systems, [and] built upon the output of innate perceptual analyzers’ (Carey & Spelke 1996, p. 520).

The CLSTX Conjecture

Four- and five-month-olds’ abilities to track briefly unperceived objects are not grounded on belief or knowledge: instead they are consequences of the operations of a system of object indexes. (Leslie et al. 1998; Scholl & Leslie 1999; Carey & Xu 2001; Scholl 2007; Carey 2009).

An *object index* is ‘a mental token that functions as a pointer to an object’ (Leslie et al. 1998, p. 11).

The *object-specific preview benefit* is the reduction in time needed to identify that a letter (or other feature) matches a target presented earlier when the letter and target both appear on the same object rather than on different objects.

Object indexes ...

- guide ongoing action (e.g. visual tracking, reaching)
- influence how attention is allocated (Flombaum et al. 2008)
- can be assigned in ways incompatible with beliefs and knowledge (e.g. Mitroff et al. 2005; Mitroff & Alvarez 2007)
- have behavioural and neural markers, in adults and infants (Richardson & Kirkham 2004; Kaufman et al. 2005).
- are subject to signature limits (Carey 2009, pp. 83–87)

- sometimes survive occlusion (Flombaum & Scholl 2006)

A *signature limit of a system* is a pattern of behaviour the system exhibits which is both defective given what the system is for and peculiar to that system.

Objects Represented Motorically

In adults, merely observing a handled object that appears within reach produces brain activity linked to the hand with which it could most readily be grasped (Cardellicchio et al. 2011).

Putting a barrier (even a translucent one) between you and a graspable object eliminates or greatly reduces the tendency to represent the object motorically (e.g. Costantini et al. 2010).

Revised CLSTX Conjecture: Four- and five-month-olds' abilities to track briefly unperceived objects are also consequences of a further, independent capacity to track physical objects which involves motor representations and processes.

Prediction: When occluders and barriers are deconfounded, infants' performance is consistent with the Revised CLSTX Conjecture (see McCurry et al. 2009).

Metacognitive Feelings

Problem for the CLSTX Conjecture: How could the operations of object indexes explain purposive actions like looking longer at one thing than another?

'metacognitive feelings ... allow a transition from the ... automatic mode to the ... controlled mode of operation' (Koriat 2000, p. 150).

'the causal antecedents of ... feelings can be said to be metacognitive insofar as they involve implicit monitoring mechanisms that are sensitive to non-intentional properties of first-order cognitive processes' (Dokic 2012, p. 310).

Metacognitive feelings are aspects of the overall phenomenal character of experiences which their subjects take to be informative about things that are only distantly related (if at all) to the things that those experiences intentionally relate the subject to; and whose normal causes include processes which monitor cognitive processes.

'the SoA [sense of agency] may provide an important experiential marker, both for alerting to the need for corrective action, and for guiding learning' (Sidarus et al. 2017, p. 11).

Feeling of Surprise: 'the effect of unexpectedness on surprise is [...] partly mediated by mental interference' (Reisenzein 2000, p. 271). 'Experienced surprise is a metacognitive assessment of the cognitive work carried out to explain an

outcome' (Foster & Keane 2015, p. 79).

Metacognitive feelings can be thought of as *sensations* in approximately Reid's sense: they are monadic properties of events, specifically perceptual experiences, which are individuated by their normal causes and which alter the overall phenomenal character of those experiences in ways not determined by the experiences' contents (compare Reid 1785a,b).

Development is Rediscovery

If the starting point is object indexes and metacognitive feelings, how do you get from there to knowledge proper?

Orthodox views inexplicitly rely on *The Assumption of Representational Connections*: the transition involves operations on the contents of core knowledge states, which transform them into (components of) the contents of knowledge states (e.g. Spelke 2000; Leslie 1988; Karmiloff-Smith 1992; Mandler 1992).

Alternative Conjecture: Only metacognitive feelings (and behaviours and other intentional isolators) connect early-developing processes for tracking objects, causes, actions and minds to the epistemic.

1. Metacognitive feelings can create create stop-and-think moments on the basis of mental interference in the operation of early-developing, automatic processes.

2. Metacognitive feelings are *intentional isolators*: they have no intentional objects (or none that are related to what they are usually taken them to be about).

Development is rediscovery: the emergence of knowledge involves rediscovering information already encoded in the operations of object indexes.

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