Lecture 05: The Developmental Origins of Knowledge of Physical Objects

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'… '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?

1. 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 occluded object is for it to nonaccidentally depend in some way on the occluded object's path.

2. 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).

3. 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.

4. 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).

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