# Origins of Mind: Lecture 03

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## 1. Objects vs Features

Knowledge of objects depends on abilities to (i) segment objects, (ii) represent them as persisting and (iii) track their interactions.

The question for this lecture is, How do humans come to meet the three requirements on knowledge of objects?

## 2. Segmentation and the Principles of Object Perception

**Principles of Object Perception (Spelke 1990)**

cohesion—'two surface points lie on the same object only if the points are linked by a path of connected surface points'

boundedness—'two surface points lie on distinct objects only if no path of connected surface points links them'

rigidity—'objects are interpreted as moving rigidly if such an interpretation exists'

no action at a distance—'separated objects are interpreted as moving independently of one another if such an interpretation exists'

What is the status of these principles?

1. We (as perceivers) start with a cross-modal representation of three-dimensional perceptual features which includes their locations and trajectories.

2. Our task is to get from these representations of features to representations of objects.

3. *Descriptive component* We do this as if in accordance with certain principles (cohesion, boundedness, rigidity, and no action at a distance).

4. *Explanatory component* We acquire representations of objects because we apply the principles to representations of features and draw appropriate inferences.

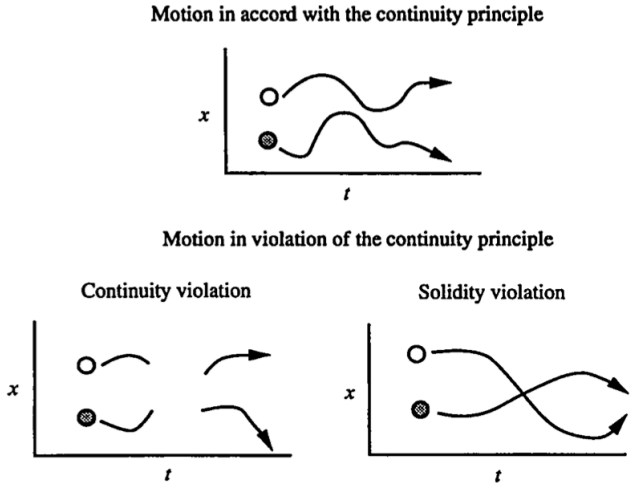
'Chomsky's nativism is primarily a thesis about knowledge and belief; it aligns problems in the theory of language with those in the theory of knowledge. Indeed, as often as not, the vocabulary in which Chomsky frames linguistic issues is explicitly epistemological. Thus, the grammar of a language specifies what its speaker/hearers have to know qua speakers and hearers; and the goal of the child's language acquisition process is to construct a theory of the language that correctly expresses this grammatical knowledge.' (Fodor 2000, p. 11)

### 2.1. The simple view

The principles of object perception are things that we know, and we generate expectations from these principles by a process of inference.

## 3. From Segmentation to Permanence

*Principle of continuity* An object traces exactly one connected path over space and time (Spelke et al. 1995, p. 113).



## 4. Permanence

Object permanence is found in nonhuman animals including

1. monkeys (Santos et al. 2006)
2. lemurs (Deppe et al. 2009)
3. crows (Hoffmann et al. 2011)
4. dogs and wolves (Fiset & Plourde 2013)
5. cats (Triana & Pasnak 1981)
6. chicks (Chiandetti & Vallortigara 2011)
7. dolphins (Jaakkola et al. 2010)
8. ...

Interpreting violation-of-expectation experiments:

'evidence that infants look reliably longer at the unexpected than at the expected event is taken to indicate that they (1) possess the expectation under investigation; (2) detect the violation in the unexpected event; and (3) are surprised by this violation. The term surprise is used here simply as a short-hand descriptor, to denote a state of heightened attention or interest caused by an expectation violation.' (Wang et al. 2004, p. 168)

'To make sense of such results [i.e. the results from violation-of-expectation tasks], we … must assume that infants, like older learners, formulate … hypotheses about physical events and revise and elaborate these hypotheses in light of additional input.' (Aguiar & Baillargeon 2002, p. 329)

'action demands are not the only cause of failures on occlusion tasks' (Shinskey 2012, p. 291)

'These dissociations cast doubt on the view that visual search and preferential looking depend on a single mechanism […] operating in accord with a single set of principles. [...] 'infants' ability to perceive object identity over occlusion, as assessed in preferential looking tasks, and to track objects visually, as assessed in visual search tasks, do not draw on a single system of knowledge. [...]

'In Fodor's (1983) terms, visual tracking and preferential looking each may depend on modular mechanisms.' (Spelke et al. 1995, p. 137)

## 5. Causal Interactions

'object perception reflects basic constraints on the motions of physical bodies …' (Spelke 1990, p. 51)

'A single system of knowledge … appears to underlie object perception and physical reasoning' (Carey & Spelke 1994, p. 175)

'A similar permanent dissociation in understanding object support relations might exist in chimpanzees. They identify impossible support relations in looking tasks, but fail to do so in active problem solving.' (Gómez 2005)

'to date, adult primates' failures on search tasks appear to exactly mirror the cases in which human toddlers perform poorly.' (Santos & Hood 2009, p. 17)

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