Origins of Mind: Lecture 02

s.butterfill@warwick.ac.uk

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

'infants perceive the boundaries of a partly hidden object by analyzing the movements of its surfaces: infants perceived a connected object when its ends moved in a common translation behind the occluder. Infants do not appear to perceive a connected object by analyzing the colors and forms of surfaces: they did not perceive a connected object when its visible parts were stationary, its color was homogeneous, its edges were aligned, and its shape was simple and regular' (Kellman & Spelke 1983).

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)

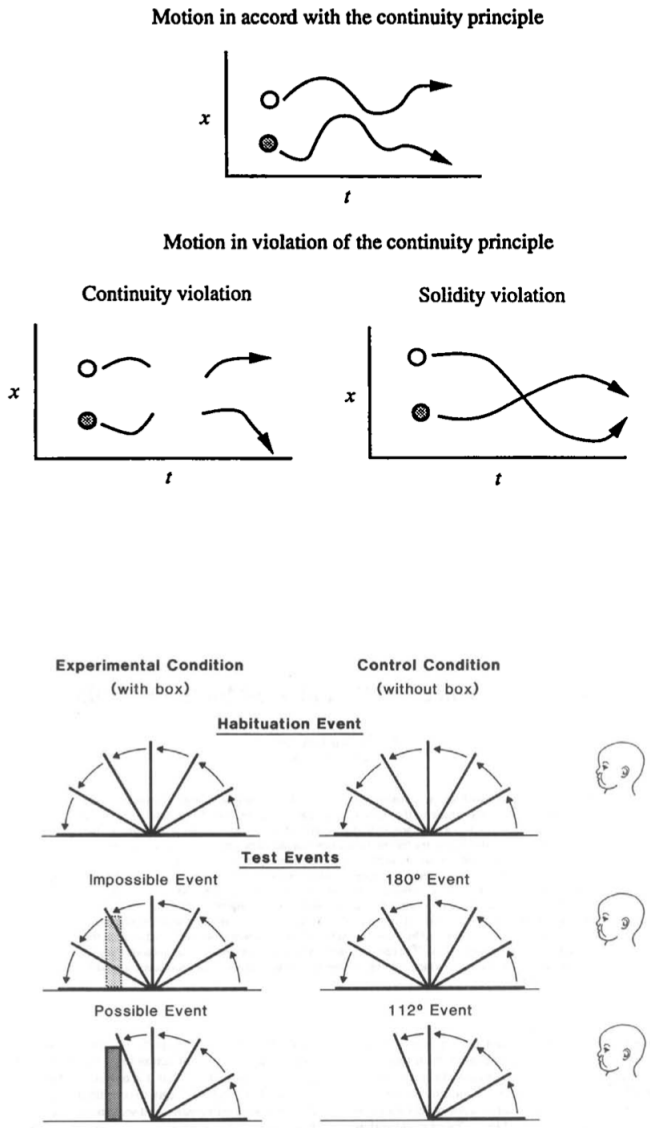
2.1. The simple view

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

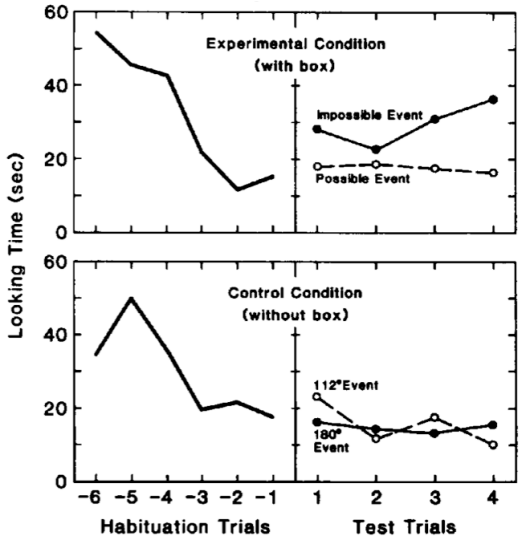
3. Permanence

Object permanence: the ability to know things about, or represent, objects you aren't currently perceiving.

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



Baillargeon 1987 figure 1



Baillargeon 1987 figure 2

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)

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. …

4. 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)

5. Recap and Questions

Question 1 How do humans come to meet the three requirements on knowledge of objects?

Discovery 1 Infants manfiest all three abilities from around four months of age or earlier.

Discovery 2 Although abilities to segment objects, to represent them as persisting through occlusion and to track their causal interactions are conceptually distinct, they may all be consequences of a single mechanism (in humans and perhaps in other animals).

Question 2 What is the relation between the principles of object perception and infants' looking behaviours?

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

6. A Problem

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

'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)

7. Like Knowledge and Like Not Knowledge

'no concept causes more problems in discussions of infant cognition than that of representation' (Haith 1998).

References

Aguiar, A. & Baillargeon, R. (2002). Developments in young infants' reasoning about occluded objects. *Cognitive Psychology*, *45*, 267–336.

Baillargeon, R. (1987). Object permanence in 3.5-and 4.5-month-old infants. *Developmental psychology*, *23*(5), 655–664.

Carey, S. & Spelke, E. (1994). Domain-specific knowledge and conceptual change. In L. Hirschfeld & S. Gelman (Eds.), *Mapping the Mind: domain specificity in cognition and culture*. Cambridge: Cambridge University Press.

Chiandetti, C. & Vallortigara, G. (2011). Intuitive physical reasoning about occluded objects by inexperienced chicks. *Proceedings of the Royal Society B: Biological Sciences*, *278*(1718), 2621–2627.

Deppe, A. M., Wright, P. C., & Szelistowski, W. A. (2009). Object permanence in lemurs. *Animal Cognition*, *12*(2), 381–388.

Fiset, S. & Plourde, V. (2013). Object permanence in domestic dogs (canis lupus familiaris) and gray wolves (canis lupus). *Journal of Comparative Psychology*, *127*(2), 115–127.

Fodor, J. (2000). *The mind doesn't work that way : the scope and limits of computational psychology*. Representation and mind. Cambridge, Mass.: MIT Press.

Gómez, J.-C. (2005). Species comparative studies and cognitive development. *Trends in Cognitive Sciences*, *9*(3), 118–125.

Haith, M. (1998). Who put the cog in infant cognition? is rich interpretation too costly? *Infant Behavior and Development*, *21*(2), 167–179.

Hoffmann, A., Rüttler, V., & Nieder, A. (2011). Ontogeny of object permanence and object tracking in the carrion crow, corvus corone. *Animal Behaviour*, *82*(2), 359–367.

Jaakkola, K., Guarino, E., Rodriguez, M., Erb, L., & Trone, M. (2010). What do dolphins (tursiops truncatus) understand about hidden objects? *Animal Cognition*, *13*(1), 103–120.

Kellman, P. J. & Spelke, E. S. (1983). Perception of partly occluded objects in infancy. *Cognitive Psychology*, *15*(4), 483–524.

Santos, L. R. & Hood, B. M. (2009). Object representation as a central issue in cognitive science. In B. M. Hood & L. R. Santos (Eds.), *The Origins of Object Knowledge* (pp. 1–23). Oxford: Oxford University Press.

Santos, L. R., Seelig, D., & Hauser, M. D. (2006). Cotton-top tamarins' (saguinus oedipus) expectations about occluded objects: A dissociation between looking and reaching tasks. *Infancy*, *9*(2), 147–171.

Shinskey, J. L. (2012). Disappearing décalage: Object search in light and dark at 6 months. *Infancy*, *17*(3), 272–294.

Spelke, E. (1990). Principles of object perception. *Cognitive Science*, *14*, 29–56.

Spelke, E. S., Kestenbaum, R., Simons, D. J., & Wein, D. (1995). Spatiotemporal continuity, smoothness of motion and object identity in infancy. *British Journal of Developmental Psychology*, *13*(2), 113–142.

Triana, E. & Pasnak, R. (1981). Object permanence in cats and dogs. *Animal Learning & Behavior*, *9*(1), 135–139.

Wang, S.-h., Baillargeon, R., & Brueckner, L. (2004). Young infants' reasoning about hidden objects: evidence from violation-of-expectation tasks with test trials only. *Cognition*, *93*(3), 167–198.