

Minimal Models of the Physical and of the Mental

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Mindreading is the process of identifying mental states and actions as the mental states and actions of a particular subject on the basis, ultimately, of bodily configurations, movements and their effects.

1. Systems

‘the process architecture of social cognition is still very much in need of a detailed theory’ (Adolphs 2010, p. 759)

A process is *automatic* to the degree that whether it occurs is independent of its relevance to the particulars of the subject’s task, motives and aims.

For a system to *track* a subject’s belief that p for its normal operations to nonaccidentally depend in some way on whether this subject believes that p .

Claims:

1. Some processes involved in tracking others’ beliefs are automatic, and some are not.
2. In a single subject on a single trial, different responses can carry conflicting information about another’s belief.

2. Models

A *signature limit* of a model is a set of predictions derivable from the model which are incorrect, and which are not predictions of other models under consideration.

Claims

1. There are multiple models of the mental.
2. Mindreading is any process which uses one of these models to track mental states.
3. Different models of the mental have different signature limits.
4. Different models provide different efficiency-flexibility trade offs.

3. Minimal theory of mind

An agent’s *field* is a set of objects related to the agent by proximity, orientation and other factors.

First approximation: an agent *encounters* an object just if it is in her field.

A *goal* is an outcome to which one or more actions are, or might be, directed.

Principle 1: one can’t goal-directedly act on an object unless one has encountered it.

Applications: subordinate chimps retrieve food when a dominant is not informed of its location (Hare et al. 2001); when observed scrub-jays prefer to cache in shady, distant and occluded loca-

tions (Dally et al. 2004; Clayton et al. 2007).

First approximation: an agent *registers* an object at a location just if she most recently encountered the object at that location.

A registration is *correct* just if the object is at the location it is registered at.

Principle 2: correct registration is a condition of successful action.

Applications: 12-month-olds point to inform depending on their informants’ goals and ignorance (Liszkowski et al. 2008); chimps retrieve food when a dominant is misinformed about its location (Hare et al. 2001); scrub-jays observed caching food by a competitor later re-cache in private (Clayton et al. 2007).

Principle 3: when an agent performs a goal-directed action and the goal specifies an object, the agent will act as if the object were actually in the location she registers it at.

4. Models and Systems

Claim Constructing minimal theories of mind yields models of the mental which ...

1. ... could be used by automatic mindreading processes.
2. ... are used by some automatic mindreading processes.
3. ... are the only models used by automatic mindreading processes.

5. Development

For adults and children represent perceptions and beliefs as such, doing so—and even merely holding in mind what another believes, where no inference is required—involves a measurable processing cost (Apperly et al. 2008, 2010), consumes attention and working memory in fully competent adults Apperly et al. 2009; Lin et al. 2010; McKinnon & Moscovitch 2007, may require inhibition (Bull et al. 2008) and makes demands on executive function (Apperly et al. 2004; Samson et al. 2005).

Claims

1. Mindreading systems using minimal models of the mental are present in infancy.
2. Infants' only mindreading systems are those which use minimal models of the mental.
3. Automatic mindreading processes in human adults also occur in 0/1-year-olds, scrub jays, chimps,

References

- Adolphs, R. (2010). Conceptual challenges and directions for social neuroscience. *Neuron*, 65(6), 752–767.
- Apperly, I., Back, E., Samson, D., & France, L. (2008). The cost of thinking about false beliefs: Evidence from adults' performance on a non-inferential theory of mind task. *Cognition*, 106(3), 1093–1108.
- Apperly, I., Carroll, D., Samson, D., Humphreys, G., Qureshi, A., & Moffitt, G. (2010). Why are there limits on theory of mind use? evidence from adults' ability to follow instructions from an ignorant speaker. *The Quarterly Journal of Experimental Psychology*, 63(6), 1201–1217.
- Apperly, I., Samson, D., Chiavarino, C., & Humphreys, G. (2004). Frontal and temporo-parietal lobe contributions to theory of mind: Neuropsychological evidence from a false-belief task with reduced language and executive demands. *Journal of Cognitive Neuroscience*, 16(10), 1773–1784.
- Apperly, I. A., Samson, D., & Humphreys, G. W. (2009). Studies of adults can inform accounts of theory of mind development. *Developmental Psychology*, 45(1), 190–201.
- Bull, R., Phillips, L., & Conway, C. (2008). The role of control functions in mentalizing: Dual-task studies of theory of mind and executive function. *Cognition*, 107(2), 663–672.
- Buttelmann, D., Carpenter, M., & Tomasello, M. (2009). Eighteen-month-old infants show false belief understanding in an active helping paradigm. *Cognition*, 112(2), 337–342.
- Butterfill, S. & Apperly, I. A. (2013). How to construct a minimal theory of mind. *Mind and Language*, 28(5), 606–637.
- Clayton, N. S., Dally, J. M., & Emery, N. J. (2007). Social cognition by food-caching corvids. the western scrub-jay as a natural psychologist. *Philosophical Transactions of the Royal Society B*, 362, 507–552.
- Dally, J. M., Emery, N. J., & Clayton, N. S. (2004). Cache protection strategies by western scrub-jays (*aphelocoma californica*): hiding food in the shade. *Proceedings of the Royal Society B: Biological Sciences*, 271(0), S387–S390–S387–S390.
- Hare, B., Call, J., & Tomasello, M. (2001). Do chimpanzees know what conspecifics know? *Animal Behaviour*, 61(1), 139–151.
- Hubbard, T. L. (2013). Launching, Entraining, and Representational Momentum: Evidence Consistent with an Impetus Heuristic in Perception of Causality. *Axiomathes*, 23(4), 633–643.
- Keren, G. & Schul, Y. (2009). Two is not always better than one. *Perspectives on Psychological Science*, 4(6), 533 – 550.
- Kozhevnikov, M. & Hegarty, M. (2001). Impetus beliefs as default heuristics: Dissociation between explicit and implicit knowledge about motion. *Psychonomic Bulletin & Review*, 8(3), 439–453.
- Lin, S., Keysar, B., & Epley, N. (2010). Reflexively mind-blind: Using theory of mind to interpret behavior requires effortful attention. *Journal of Experimental Social Psychology*, 46(3), 551–556.
- Liszkowski, U., Carpenter, M., & Tomasello, M. (2008). Twelve-month-olds communicate helpfully and appropriately for knowledgeable and ignorant partners. *Cognition*, 108(3), 732–739.
- McKinnon, M. C. & Moscovitch, M. (2007). Domain-general contributions to social reasoning: Theory of mind and deontic reasoning re-explored. *Cognition*, 102(2), 179–218.
- Onishi, K. H. & Baillargeon, R. (2005). Do 15-month-old infants understand false beliefs? *Science*, 308(8), 255–258.
- Samson, D., Apperly, I., Kathirgamanathan, U., & Humphreys, G. (2005). Seeing it my way: a case of a selective deficit in inhibiting self-perspective. *Brain*, 128(5), 1102–1111.
- Schneider, D., Lam, R., Bayliss, A. P., & Dux, P. E. (2012). Cognitive load disrupts implicit theory-of-mind processing. *Psychological Science*, 23(8), 842–847.
- Southgate, V., Senju, A., & Csibra, G. (2007). Action anticipation through attribution of false belief by two-year-olds. *Psychological Science*, 18(7), 587–592.