Lecture 07: A Dual-Process Theory of Mindreading

s.butterfill@warwick.ac.uk

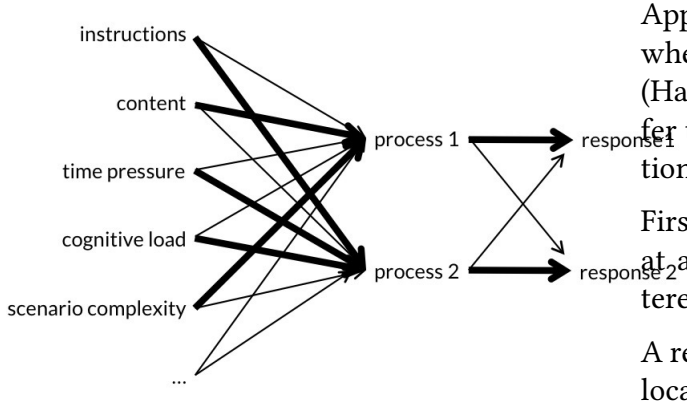
1. Three Questions

Q1: What do infants, chimps and scrub-jays reason about, or represent, that enables them, within limits, to track others' perceptions, knowledge, beliefs and other propositional attitudes?

Q2: Why do infants manifest abilities to track beliefs in some cases but not all?

Q3: Why is belief-tracking in adults sometimes but not always automatic? (And how could belief-tracking ever be automatic if it significantly depends on working memory and consumes attention?)

2. Dual-process Theory



Dual Process Theory (core part): Two (or more) processes for tracking Xs are distinct: the conditions which influence whether they occur, and which outputs they generate, do not completely overlap.

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 locations (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; Emery & Clayton 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.

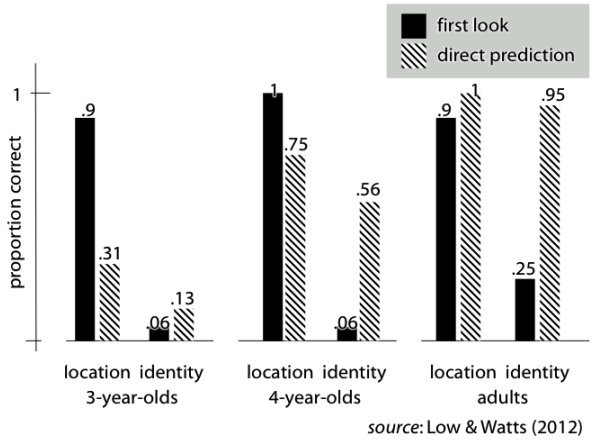
Applications: some false belief tasks (Onishi & Baillargeon 2005; Southgate et al. 2007; Buttelmann et al. 2009).

4. Signature Limits

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. (See Wang et al. 2015; Low 2010; Low et al. 2014; Edwards & Low 2017; contrast Scott et al. 2015.)

Automatic belief-tracking in adults and belief-tracking in infants are both subject to signature limits associated with minimal theory of mind (Wang et al. 2015; Low & Watts 2013; Low et al. 2014; Mozuraitis et al. 2015; contrast Scott et al. 2015).

	Propositional attitude	Relational attitude
level-1 perspective taking	Y	Y
level-2 perspective taking	Y	N
false beliefs about non-existence	Y	N
false beliefs about location	Y	Y
false beliefs about identity	Y	N



For adults (and children who can do this), representing perceptions and beliefs as such—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).

5. Objections

'the theoretical arguments offered [...] are [...] unconvincing, and [...] the data can be explained in other terms' (Carruthers 2015b; see also Carruthers 2015a).

'A cooperative multi-system architecture is better able to explain infant belief representation than a parallel architecture, and causal representation, schemas and models provide a more promising basis for flexible belief representation than does a rule-based approach of the kind described by Butterfill and Apperly' (Christensen & Michael 2016; see also Michael & Christensen 2016; Michael et al. 2013).

6. What about Development?

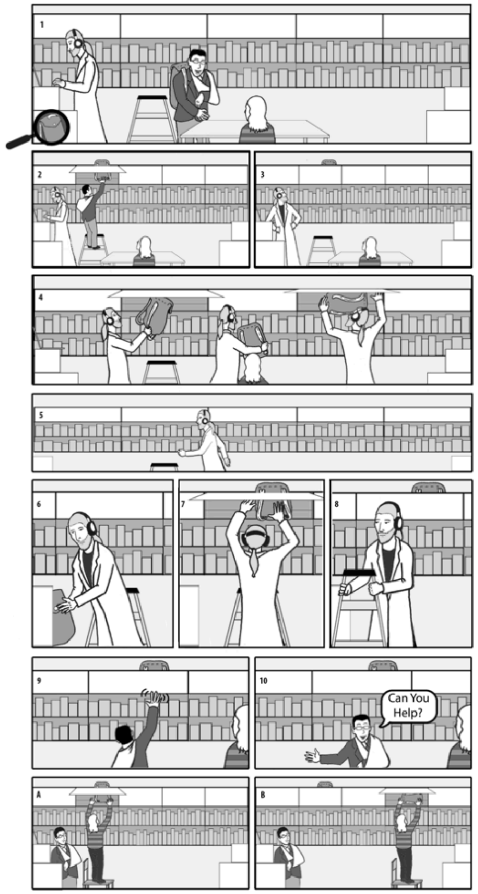
1. Automatic and nonautomatic mindreading processes both occur from the first year of life onwards.

2. The model of minds and actions underpinning automatic mindreading process does not significantly change over development.

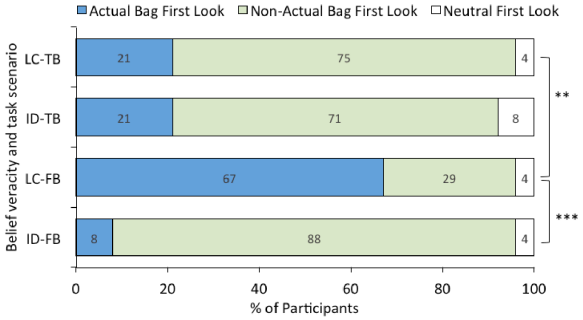
3. In the first three or four years of life, nonautomatic mindreading processes involve relatively crude models of minds and actions, models which do not enable belief tracking.

4. What changes over development is typically just that the model underpinning nonautomatic mindreading becomes gradually more sophisticated and eventually comes to enable belief tracking.

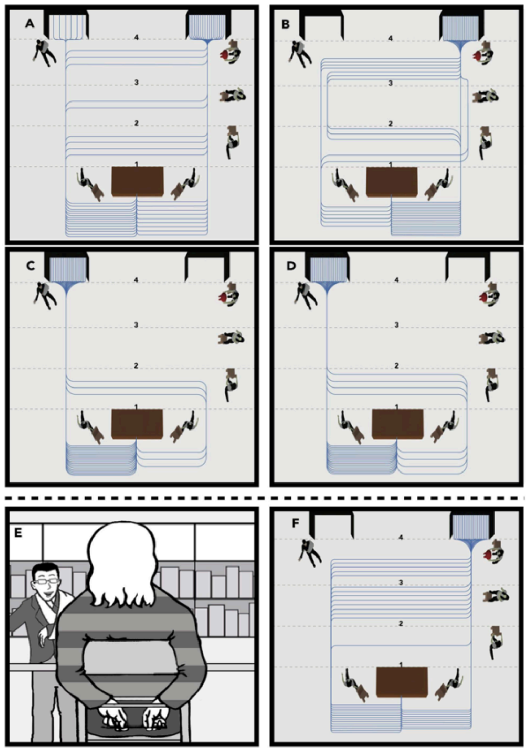
7. Maymon, Sivanantham, Low & Butterfill (pilot)



Sequence of events (1 – 10) in the FB-identity condition.



% of participants displaying type of first look by condition (**P = 0.005; ***P < 0.001).



Schematic representation of individuals' (N = 96) course of action in Experiment 1 between conditions: (A) FB-identity, (B) FB-location, (C) TB-identity, and (D) TB-location. The course was divided into 4 stages: (1) swerving, (2) advancing, (3) reaching, and (4) ultimately handing over the actual or non-actual bag (dotted lines represent thresholds for each stage). In Experiment 2, we examined how stalling of motor representations, by temporarily tying individual observers' hands (E), affected the course of their (N = 24) helping action in the FB-location condition (F).

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