Minimal Theory of Mind & Joint Action

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I. Minimal Theory of Mind

1. Abilities vs. cognition

A *theory of mind ability* is an ability that exists in part because exercising it brings benefits obtaining which depends on exploiting or influencing facts about others' mental states.

Theory of mind cognition paradigmatically involves ascribing propositional attitudes such as beliefs, desires and intentions to give rationalising causal explanations of action.

2. Theory of mind abilities are widespread

Children in their second year use pointing to provide information to others[13] in ways that reflect their partners' ignorance or knowledge;[14] provide more information to ignorant than knowledgeable partners when making requests;[18] predict actions of agents with false beliefs about the locations of objects;[19,23] and select different ways of helping others depending on whether their beliefs are true or false.[3]

Scrub-jays selectively re-cache their food in ways that prevent competitors from knowing its location.[4]

Chimpanzees select routes to approach food which conceal them from a competitor's view,[9] and retrieve food using strategies that optimise their return given what a dominant competitor has seen.[8]

3. Theory of mind cognition is hard

Conceptually demanding:

- Acquisition takes several years[25,24]
- Tied to the development of executive function[20,21] and language[2]
- Development facilitated by explicit training[22] and siblings[5,10]

Cognitively demanding:

- Requires attention and working memory in fully competent adults[1,16]

4. Puzzle

What could two-year-olds, scrub-jays, chimpanzees and human adults under load represent that would enable them, within limits, to track others' propositional attitudes?

5. The construction

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

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. A *goal-state* is an intention or other state of an agent linking an action to a particular goal to which it is directed.

A *goal-directed action* is a sequence of object-directed actions, which (1) has an outcome that is an outcome of the whole sequence and not any of its constituents, and (2) occurs in order to bring about this outcome.

Principle 3: one can't goal-directedly act on an object unless one has encountered it.

Application: subordinate chimps retrieve food when a dominant is not informed of its location.[8]

Application: when observed scrub-jays prefer to cache in shady, distant and occluded locations.[6,4]

An agent *registers* an object at a location [first approximation] 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 4: correct registration is a condition of successful action.

Applications: 12-month-olds point to inform depending on their informants' goals and ignorance;[14] chimps retrieve food when a dominant is misinformed about its location;[8] scrub-jays observed caching food by a competitor later re-cache in private.[4,7]

Principle 5: 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: false belief tasks[19,23,3]

II. Joint Action

'the unique aspects of human cognition ... were driven by, or even constituted by, social cooperation. ... [R]egular participation in cooperative, cultural interactions during ontogeny leads children to construct uniquely powerful forms of cognitive representation.'[17]

'perception, action, and cognition are grounded in social interaction … functions traditionally considered hallmarks of individual cognition originated through the need to interact with others'[11]

6. What is joint action?

A *joint action* is an event with two or more agents.[15]

A *goal-directed joint action* is a joint action which, taken as a whole, is directed to a goal.

Distributive goal. The *distributive goal* of two or more actions is G: (a) each action is individually directed to G; and (b) it is possible that: all actions succeed relative to this outcome.

Collective goal. The *collective goal* of two or more actions is G: (a) G is a distributive goal of the outcomes; (b) the actions are coordinated; and (c) coordination of this type would normally facilitate occurrences of outcomes of G's type

Shared goal. The *shared goal* of two or more agents' actions is G: (a) G is a collective goal of their actions; (b) each agent can identify each of the other agents in a way that doesn't depend on knowledge of the goal or actions directed to it; (c) each agent most wants and expects each of the other agents to perform actions directed to G; and (d) each agent most wants and expects G to occur as a common effect of all their goal-directed actions, or to be partly constituted by all of their goal-directed actions.

7. From minimal to full theory of mind

ordinary 3rd person interpretation: we determine which outcomes her behaviour is a means of bringing about and then suppose that the goals of her actions are to bring about one or more of these outcomes.

the problem of opaque means: ordinary 3rd person interpretation may fail when it is not known which outcomes a behaviour is a means of bringing about, especially where a novel tool or communicative device is used.

your-goal-is-my-goal: (1) We are about to engage in some joint action; (2) I am not about to change my goal; therefore (3) The others will each individually perform actions directed to my goal.

'to understand pointing, the subject needs to understand more than the individual goal-directed behaviour. She needs to understand that ... the other attempts to communicate to her ... and ... the communicative intention behind the gesture'[17]

'the adult's social cues conveyed her communicative intent, which in turn encouraged the child to 'see through the sign'.'[12]

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