

11: The Motor Theory of Goal Tracking

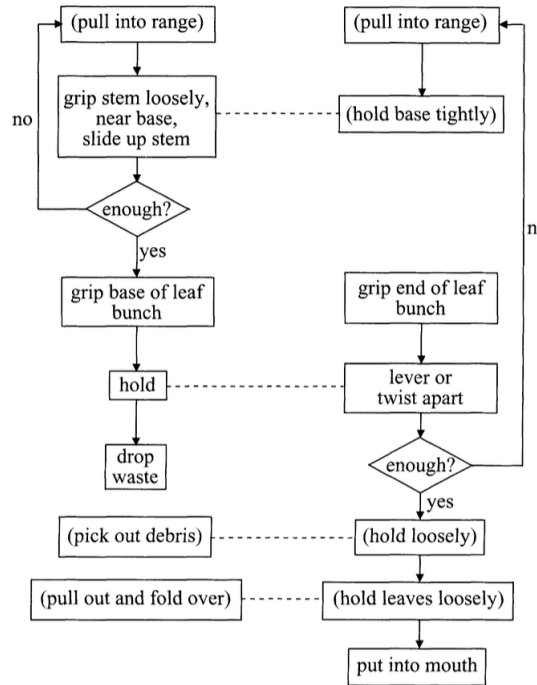
s.butterfill@warwick.ac.uk

1. Pure Goal Tracking

An account of *pure goal tracking* is an account of how you could in principle infer facts about the goals to which actions are directed from facts about joint displacements, bodily configurations and their effects (e.g. sounds).

Goal tracking matters for (i) identifying intentions and other mental states (Newtson et al. 1977, p. 861; Baldwin et al. 2001, p. 708); (ii) efficiently representing events (Kurby & Zacks 2008); (iii) identifying the likely effects of actions (Byrne 1999); (iv) predicting when an event likely to be of interest will occur (Swallow & Zacks 2008, p. 121); and (v) learning through observation how to do things (Byrne 2003).

...And of course a special case of pure behaviour reading, 'speech perception', underpins communication by language in humans.



'great apes [are] able to acquire complex and elaborate local traditions of food acquisition, some of them involving tool use' (Byrne 2003, p 513)

2. The Teleological Stance

'an action can be explained by a goal state if, and only if, it is seen as the most justifiable action towards that goal state that is available within the constraints of reality' (Csibra & Gergely 1998, p. 255)

These facts:

1. action a is directed to some goal;
2. actions of a 's type are normally capable of being means of realising outcomes of G 's type in situations with the salient (to any concerned) features of this situation;
3. no alternative type of action is both typically available to agents of this type and also such that actions of this type would be normally be significantly better¹ means of realising outcome G in situations with the salient features of this situation;
4. the occurrence of outcome G is typically desirable for agents of this type;

and

5. there is no other outcome, G' , the occurrence of which would be at least comparably desirable for agents of this type and where (2) and (3) both hold of G' and a

may jointly constitute defeasible evidence for the conclusion that:

6. G is a goal to which action a is directed.

Claim: the above inference, from (1)-(5) to (6), is a route to knowledge of the goals of actions in this sense: in some cases it would be possible to

know the premises without already knowing the conclusion; and, in some of those cases, knowing the premises could put one in a position to know the conclusion.

An action of type a' is a *better* means of realising outcome G in a given situation than an action of type a if, for instance, actions of type a' normally involve less effort than actions of type a in situations with the salient features of this situation and everything else is equal; or if, for example, actions of type a' are normally more likely to realise outcome G than actions of type a in situations with the salient features of this situation and everything else is equal.

3. The Motor Theory of Goal Tracking

3.1. The Simple View

‘when taking the teleological stance one-year-olds apply the same inferential principle of rational action that drives everyday mentalistic reasoning about intentional actions in adults’ (Gergely & Csibra 2003; compare Csibra et al. 2003, Csibra & Gergely 1998, p. 259)

‘Such calculations require detailed knowledge of biomechanical factors that determine the motion capabilities and energy expenditure of agents. However, in the absence of such knowledge, one can appeal to heuristics that approximate the results of these calculations on the basis of knowl-

edge in other domains that is certainly available to young infants. For example, the length of pathways can be assessed by geometrical calculations, taking also into account some physical factors (like the impenetrability of solid objects). Similarly, the fewer steps an action sequence takes, the less effort it might require, and so infants’ numerical competence can also contribute to efficiency evaluation.’ (Csibra & Gergely 2013)

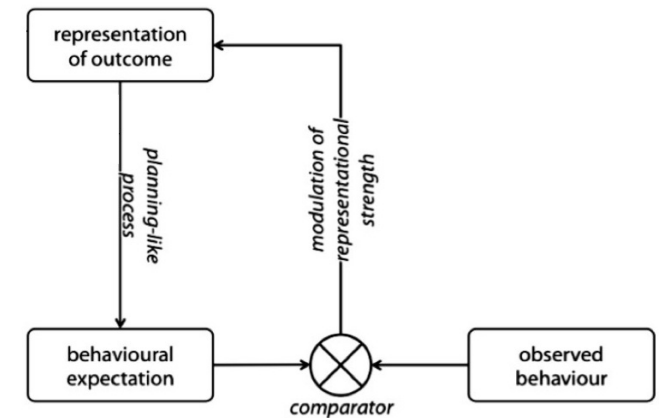
3.2. The Motor Theory

According to the *Motor Theory of Goal Tracking*, infants (and adults) sometimes track the goals of others’ by means of motor processes (see Siniaglia & Butterfill 2015, for details).

More carefully the *Motor Theory of Goal Tracking* states that:

1. in action observation, possible outcomes of observed actions are represented motorically;
2. these representations trigger motor processes much as if the observer were performing actions directed to the outcomes;
3. such processes generates predictions;
4. a triggering representation is weakened if the predictions it generates fail.

The result is that, often enough, the only only outcomes to which the observed action is a means are represented strongly.



4. Marr’s Threefold Distinction

Marr (1982, p. 22ff) distinguishes:

- computational description—What is the thing for and how does it achieve this?
- representations and algorithms—How are the inputs and outputs represented, and how is the transformation accomplished?
- hardware implementation—How are the representations and algorithms physically realised?

References

- Baldwin, D., Baird, J. A., Saylor, M. M., & Clark, M. A. (2001). Infants parse dynamic action. *Child Development*, 72(3), 708–717.
- Byrne, R. W. (1999). Imitation without intentionality. using string parsing to copy the organization of behaviour. *Animal Cognition*, 2(2), 63–72.
- Byrne, R. W. (2003). Imitation as behaviour parsing. *Philosophical Transactions: Biological Sciences*, 358(1431), 529–536.
- Csibra, G., Bíró, S., Koós, O., & Gergely, G. (2003). One-year-old infants use teleological representations of actions productively. *Cognitive Science*, 27(1), 111–133.
- Csibra, G. & Gergely, G. (1998). The teleological origins of mentalistic action explanations: A developmental hypothesis. *Developmental Science*, 1(2), 255–259.
- Csibra, G. & Gergely, G. (2013). Teleological understanding of actions. In M. Banaji & S. A. Gelman (Eds.), *Navigating the Social World: What Infants, Children, and Other Species Can Teach Us* (pp. 37–43). Oxford: Oxford University Press.
- Gergely, G. & Csibra, G. (2003). Teleological reasoning in infancy: the naive theory of rational action. *Trends in Cognitive Sciences*, 7(7), 287–292.
- Kurby, C. A. & Zacks, J. M. (2008). Segmentation in the perception and memory of events. *Trends in Cognitive Sciences*, 12(2), 72–79.
- Marr, D. (1982). *Vision : a computational investigation into the human representation and processing of visual information*. San Francisco: W.H. Freeman.
- Newtonson, D., Engquist, G. A., & Bois, J. (1977). The objective basis of behavior units. *Journal of Personality and Social Psychology*. Vol. 35(12), 35(12), 847–862.
- Sinigaglia, C. & Butterfill, S. A. (2015). On a puzzle about relations between thought, experience and the motoric. *Synthese*, 192(6), 1923–1936.
- Swallow, K. M. & Zacks, J. M. (2008). Sequences learned without awareness can orient attention during the perception of human activity. *Psychonomic Bulletin & Review*, 15, 116–122.