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Theory of Mind and Nonhuman Intelligence

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Synonyms

Mental state attribution; Mindreading; Social cognition

Definition

The cognitive ability to predict or explain an individuals' behavior through the attribution of mental states.

Introduction

Comparative cognition researchers have long been interested in the nature of nonhuman animal social capacities. One capacity has received prolonged attention: mindreading, or "theory of mind" ~~as it also called,~~ is often seen to be the ability to attribute mental states to others in the service of predicting and explaining behavior. This attention is garnered in no small measure from interest into what accounts for the distinctive features of human social cognition and what are the evolutionary origins of those features. This entry surveys: (1) main hypotheses concerning the adaptive value of mindreading, (2) theoretical problems complicating our ability to determine whether nonhuman animals mindread, and finally (3) proposals that mindreading is a plural rather than unitary cognitive system.

Social Intelligence Hypothesis

One intuitive idea is that mindreading evolved in response to social pressures. The Social Intelligence Hypothesis asserts that the ability to reason about the intelligent action of group members affords greater benefits as social settings become more complex (Humphrey 1976; Jolly 1966). Certain social groupings seem to require substantial cognitive control on behalf of group members. Individuals must potentially be able to recognize and track particular individuals, kin relationships, and dominance hierarchies, all of which are subject to rapid changes over time. The Social Intelligence Hypothesis holds that social environments are necessary conditions on the development of social cognitive skills like mindreading. To substantiate this hypothesis, it is important to determine whether nonhuman animals that lack the complexity of social groupings seen in similar species also lack analogous social cognition skills (Vonk et al. 2015). For instance orangutans, which are relatively solitary in relation to other great apes, are sufficiently similar with regards to social cognitive skills (Herrmann et al. 2007).

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Exactly what social cognition skills were selected for is a further question. The ability to reason about others' behavior in social contexts might be useful in out-competing conspecifics. Known under the guise of the "Machiavellian hypothesis," some argue making better predictions of others' future behavior allows for one to manipulate others through various forms of deception (Whiten and Byrne 1988). As individuals gain more sophisticated understanding of social action and greater predictive success, competition becomes tough, thus creating an evolutionary "arms race." This hypothesis interprets the coalition formation and reconciliation behavior found in many primates in terms of long-term strategic responses, though there may be more mundane reasons, such as tracking food locations that promote this behavior (see Barrett and Henzi 2005).

An alternative view, one commensurate with Alison Jolly's initial account, suggests that cooperative social learning, not competition among conspecifics, led to the development of sophisticated social cognitive skills such a mindreading (Andrews 2012a; Heyes and Frith 2014). Social learning is the transmission of information across group members within a social context. While mindreading ability may not be required to engage in forms of social learning in mimicry and imitation, other social cognition skills may be required. For example, imitation might require that agents have (i) a "natural pedagogy" or evolved interpretive biases towards demonstrators and (ii) take a teleological stance, i.e., attribute purpose, design, or function, to others (Csibra and Gergely 2005). Some comparative evidence suggests that overimitation, or the tendency to imitate demonstrators' behaviors in spite of their causal irrelevancy, is a distinctively human strategy facilitating more rapid social learning of instrumental skills and social conventions (Horner and Whiten 2004). It has been hypothesized then that our species-specific proclivity for high fidelity imitation may be linked to "cumulative cultural transmission": instrumental skills and social conventions are not only inherited across generations – imitated behaviors may be recombined in novel contexts and in innovative ways (Legare and Neilsen 2015).

The Logical Problem

It is widely held that reasoning about the intentional actions of others is a form of causal reasoning – we attribute unobservable causal determinants of others' behavior in intentional explanations just as we do when we discover what makes simple machines function. This view receives partial support from developmental research on causal reasoning. Alison Gopnik and her colleagues introduced young children to boxes called "blickets" that would light up or make a sound under various parameters, such as when some collection of objects and the device were in direct contact (Gopnik and Sobel 2000). They concluded that not only did children recruit memories of prior interactions when being asked to predict what would make the blicket work, they were sensitive to the potential causal mechanisms at work. While in many cases causal reasoning requires knowledge of the observable states of objects at different times, it sometimes requires the positing of intermediate states that are perceptually opaque yet causally relevant in the assessment of observed events. The perceptually opaque causal determinants in the case of mindreading are internal mental states – the beliefs and desires or perceptions and goals that cause the resultant behavior.

Comparative researchers disagree about the causal reasoning abilities of nonhuman animals. While Penn and Povinelli (2007) claim ~~that their~~ studies suggest that chimpanzees do not share proficiency at inferring the underlying causal structure of phenomena with humans, other researchers have found evidence of causal reasoning in great apes on a par with that which we find in human children. Völter and Call (2014) show that apes infer causal structures from the coactivation of blicket detectors similarly to young children and can recruit this knowledge in their interventions.

Assuming mindreading is analogous to causal reasoning in the way hinted above, there is further disagreement as to whether nonhuman animals' social cognitive abilities call upon unobservable intentional states. While evidence suggests that subordinate chimpanzees know what dominant chimpanzees observe when competing over a food source (Hare et al. 2000), whether their behavioral preferences involve the attribution of mental states is hotly contested. Povinelli and Vonk (2003) take issue with these and similar findings, on the grounds they are subject to "the logical problem". Assume we are deciding between two hypotheses regarding a subjects' behavior in a social context. The mindreading hypothesis assumes the subject confers mental states on some conspecific in the service of predicting their future behavioral states. The competing behavior reading hypothesis assumes she confers only behavioral states. If we are limited to the subjects' behavior when deciding between these two hypotheses, it seems just as likely that the subject relies on associations between observable behaviors in predicting the future states of conspecifics as it does that they would rely on the unobservable mental states.

Exactly what the logical problem means for comparative research and whether it can be solved is up for debate. ~~Tomasello &~~ Tomasello and Call (2006) argue that mindreading hypotheses provide the best explanation since they unify a range of very different experiments already demonstrated. Others, while not so sanguine, are hopeful that a novel experimental design could solve the problem (e.g., Lurz 2012; Heyes 2015; Sober 2015, and Bugnyar et al. 2016). Halina (2015) argues that the logical problem is not a unique theoretical dilemma for comparative researchers, so there is no special epistemic burden with regards to disproving competing behavior reading hypotheses. Andrews (2012b) similarly suggests that the logical problem is an ancillary of the philosophical problem of other minds: what justifies my attributions of mental states to others, given that my access to their mental life is always mediated through their behavior? Buckner (2014) evinces that in order to solve the logical problem, there must be a unique causal role for the contents of an agent's mental states to play in determining their action. But which interpretations of the content of internal mental states are causally efficacious, and how so? Because any observable behavior is compatible with a potentially infinite set of mental attitudes, accurate attribution that would facilitate causal reasoning about observable actions of others appears to be computationally intractable (Zadwizki 2014).

Multiple Systems Hypothesis

Just as one might distinguish between an agent's explicit, reflective, deliberate knowledge from their implicit, heuristic-based, automatic knowledge of the causal structure of some physical system, we might discover multiple processing systems for mindreading. Children can correctly verbally identify and track false beliefs at around 4 years of age. Even though some nonhuman animals consider others' perceptual perspectives, this ability is not on par with children's ability to verbally reason about others' beliefs. That said, testing false belief responsiveness by measuring preferential looking times has some now thinking that preverbal infants have mindreading skills as well (Onishi and Baillargeon 2005). Infants' surprising performance in social contexts means could help make sense of the ontogeny and phylogeny of social cognition. Some conjecture that mindreading is not a unitary process, but rather can be decomposed into unique social cognition skills that have divergent evolutionary and developmental trajectories.

Partial evidence for these views comes from variations in reaction times in belief attribution.

By comparing performance across species and developmental stages, researchers aim to identify "signature limits" which reveal the contours of mindreading abilities (Butterfill and Apperly 2013). Signature limits indicate restrictions on the performance of some relevant tasks and can help to illuminate the mechanisms involved in performing the ~~task~~. For example, while we require additional processing to report on someone's belief; it takes longer to answer questions about a person's belief than it does to answer factual questions about the situation (Back and

Apperly 2010). Perspectival information is different; perceptual information about others' point of view are automatically processed by subjects (Samson et al. 2010). These studies suggest that adults' judgments about the number of objects they could see in a visual scene were slower and more error-prone when the scene contained an irrelevant agent whose visual perspective was different, suggesting that another perspective can caused an indicative interference effect.

If mindreading was not a unitary cognitive system in humans, then nonhuman animal social skills may mirror some aspects of human capacities and not others. Still there are other ways of interpreting limitations on subjects' performance that do not necessitate the ascription of multiple processes. Subjects' performance limitations could be the result of limitations on domain general capacities such as working memory (Carruthers 2016) or infants' preferential looking times may be the result of implicit memory of the visual contact between the agent and the objects and experience with this sort of behavior (Perner ~~forthcoming~~).

Conclusion

Investigations into the social cognition skills of nonhuman animals has profited from the prolonged interaction between researchers in developmental psychology, neuroscience, ecology, anthropology, and philosophy. Above we focus on the development of research with regards to mindreading or the ability to reason about others' mental states in the service of predicting and explaining their behavior. Importantly we see the question of what is the nature of mindreading and what is its adaptive value occur in a parallel, piecemeal fashion.

Cross-References

- ▶ Ability to Recognize Individuals
- ▶ Brian Hare
- ▶ Causal Reasoning
- ▶ Cooperation and Social Cognition
- ▶ Emergence of Social Reasoning about Hierarchies
- ▶ Michael Tomasello
- ▶ Nonhuman Primates
- ▶ Predicting Events and Behavior
- ▶ Social Cognition
- ▶ The False Belief Test
- ▶ The Social Intelligence Hypothesis
- ▶ Theory of Mind

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