Success in Theory of Mind

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Introduction

Peter wants to get the beer that he left in the refrigerator. Predicting Peter's behaviour correctly is usually an easy matter, but understanding how people correctly predict his behaviour with ease is a much more difficult task. Thirty years of research on theory of mind has focused on the interesting few cases in which people fail to reason about mental states correctly, however it is perhaps more interesting to explore the common, reliable cases of successful theory of mind reasoning. This symposium presents research exploring successful instances of theory of mind reasoning using a variety of experimental approaches, and examines the ability to succeed consistently across the lifespan, with results from toddlers, preschoolers, young children, and adults. Important conclusions are drawn from the presented research, which includes the first evidence that children as young as 2.5 years of age can succeed on explicit false belief tasks (Scott & Baillargeon), the most direct behavioral evidence to date for inhibitory processing in successful behavior prediction based on false belief and avoidance desire in preschoolers and young children (Petrashek & Friedman), and, in adults, evidence from a probabilistic modeling approach to theory of mind and social learning development with extensions to pragmatic language usage and natural pedagogy (Goodman).

Why do infants succeed in false-belief tasks when toddlers fail? Evidence for a response account

Rose M. Scott & Renée Baillargeon

Recent evidence suggests that infants in the second year of life can represent a variety of different false beliefs, as well as reason about false perceptions and deception (e.g., Baillargeon, Scott, & He, in press). If infants can represent false beliefs, then why do children fail standard tasks until age 4? Here we argue that this discrepancy reflects the use of different responses. Traditional tasks require children to answer a direct question about an agent's false belief (elicited-response tasks), whereas recent tasks measure children's spontaneous reactions to a scene (spontaneous-response tasks). Simultaneously representing a false belief and planning a response may be too difficult for young children. Since spontaneous tasks do not require a planned response, children succeed much earlier. To examine this possibility, we tested 2.5-year-olds in a novel false-belief task that closely matched the demands of standard tasks but did not require answering a question. While viewing a picture book, children heard a story about an agent who hid her apple in one of two locations; in her absence, the apple was moved to the other location. In the test trial, one picture showed the agent searching for her apple where she had originally hidden it, and one picture showed the agent searching for her apple in its current location. Children looked reliably longer at the original- than at the current-location picture, suggesting that they successfully represented the agent's false belief.

We next tested whether 2.5-year-olds could succeed in an elicited-response task if the response component were made easier for them. Specifically, we provided children with practice with the required response (pointing to one of two locations). In each trial, an experimenter either recited a line of the story (story trials) or asked a question (question trials). On story trials, one picture was shown; on question trials, two pictures were shown and the question required the children to point to one of them. In the final trial, children were asked to point to where the agent would look for her apple. Most children pointed to the correct location (e.g., where the agent falsely believed her apple was

located), suggesting that even 2.5-year-olds can succeed at an elicited-response false-belief task when the response demands are reduced.

The signature of inhibition in theory of mind

Adam R. Petrashek & Ori Friedman

Three-year-olds typically fail standard false belief tasks, whereas four-year-olds typically pass. Much has been made of this transition from failure to success, and it is now widely believed that improvements in inhibitory processing during the preschool years are at least partly responsible for improvements in theory of mind reasoning during the same period (Carlson & Moses, 2001). However, the role of inhibition remains unclear. One promising possibility is that inhibitory processing is involved in certain types of explicit mental state reasoning, such as predicting behaviour based on false belief, and directly affects *how* children perform on theory of mind tasks (Leslie, Friedman, & German, 2004).

Our research capitalizes on the lingering property of inhibition – once a response is inhibited, this inhibition lingers, making it more difficult to select than uninhibited responses. This signature of inhibition is highlighted in inhibitory accounts of negative priming and inhibition of return, which both occur in children.

In four experiments, we provide decisive evidence for the view that inhibitory processing is necessary to make explicit behavioural predictions based on avoidance desires and false beliefs. Attributing false beliefs may require inhibiting a default tendency to attribute true beliefs and, in Experiments 1 and 2, we show that inhibition lingers after 5- and 6-year olds predict an agent's behaviour based on a false belief. Attributing avoidance desires may require identifying the target to be avoided and then inhibiting it. In Experiments 3 and 4, we show that inhibition also lingers after 3-year-olds predict behaviour based on avoidance desire. In demonstrating a signature of inhibition in children's theory of mind reasoning, these four experiments clearly support the view that inhibitory processing is involved in how children successfully predict behaviour based on avoidance desires and false beliefs.

Learning what others know

Noah D. Goodman

Civilization is possible because no human needs to re-discover every fact and idea from the natural world alone. Instead, we can learn what other humans already know. What computational processes underlie this social learning, particularly early in development, before formal schooling begins? I will describe a probabilistic modeling approach to theory of mind, which addresses this problem. In this approach an understanding of other agents as goal-directed and an assumption that they are knowledgeable about the world supports social learning which is much more rapid than learning from the natural world alone. I will apply this framework to explain several experiments on social learning, and indicate how it extends to aspects of pragmatic usage of language and natural pedagogy.

Discussant

Rebecca Saxe

An Assistant Professor at the Massachusetts Institute of Technology, Dr. Saxe utilizes a multi-method, multi-directional approach to studying the cognitive neuroscience of theory of mind in both typical and atypical populations of infants, children, and adults. Saxe has received several prestigious awards and has been published extensively in top journals, including *Trends in Cognitive Sciences*, *Psychological Science*, and *Cognition*.

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