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Journal Title: Zero to three
Volume: 30(2) **Issue:**
Month/Year: 2009 **Pages:** 28-32
Article Author: Gopnik, A **Article Title:** READING MINDS: How Infants Come to Understand Others
Imprint:

Maxcost: 32.00

[OCLC:CUY] Either the physical journal issue or a scanned pdf is ok OCLC #: 489588116 US:CCG

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Reading Minds

How Infants Come to Understand Others

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For a social species such as ours, understanding what people can do—and acting to change what they do—is even more important than understanding and changing the physical world. Many anthropologists have suggested that the development of this "Machiavellian" social intelligence was also an engine of human cognitive evolution. As individual humans, we are pathetic creatures, literally unable to keep ourselves alive. Our survival depends on our ability to understand other people and to get them to do what we want—to make alliances, construct coalitions, and form teams.

Over the past 20 years, researchers have learned a great deal about just when and how babies and young children come to understand the minds of others. Even infants seem to begin life with some assumptions about how minds work and how their own minds are similar to the minds of others. As children grow older, they develop more and more sophisticated and complex ideas about how the mind works.

One of the most exciting recent areas of investigation concerns very young infants. We have known for a long time that even young infants can recognize and prefer human faces and voices. But we can also ask if infants can understand human beings in a deeper way. Many different methods can be used to try to determine young children's psychological understanding. A common method is to use "looking time" or "habituation" techniques. These studies rely on the fact that babies look longer at unexpected events than at expected ones. By presenting babies with different series of events and seeing what they look at, we can make some inferences about what they think. Recently, researchers using these methods have interpreted the findings to mean that even very young babies have some sophisticated understandings of the mind, such as understanding that some agents help or hurt other agents (Kuhlmeier, Wynn, & Bloom, 2003) or even that someone who does not see an object will not know where that object is (Onishi & Baillargeon, 2005). However, there are also some problems with these methods. It is difficult to tell if babies are responding to more abstract conceptual aspects of the events or to more particular perceptual features (Madole & Oakes, 1999). Therefore, in this article, we focus on studies that include information not only about babies' looking times but also their actions. Converging evidence from both of these sources gives us the best reason to believe that babies really do understand the minds of others.

How Infants Think About Others

From the time they are born, infants already link aspects of their own minds and emotions with those of others. Newborn infants imitate the facial expressions of others (Meltzoff, 2007; Meltzoff & Moore, 1977). To do this, they must link what they see on the face of another person with how it feels to be that other person on the inside.

By the time they are 9 months old, babies have developed a richer understanding of others (Woodward, 2003). Seven-month-olds, for example, appreciate that actions are directed toward particular goals. In a looking-time study, researchers can show the babies two toys—say, a ball and a teddy bear—on a table. A hand reaches over and grasps the ball. Then, the locations of the two toys are switched, so that the teddy bear is now placed where the ball was and vice versa. What will the baby predict regarding what happens next? Seven-month-olds tend to predict that the researcher will reach for the ball—these babies look longer when she goes for the teddy bear instead. Even more striking, these 7-month-olds do not make this prediction if a stick, rather than a hand, touches one object or the other. Therefore, 7-month-olds know that Mom's hands, like their own hands, try to make things happen.

How do babies figure this out? Typically, babies less than 7 months old, who cannot yet reach for objects themselves, do not pass this task. Even among 7-month-olds, babies who

Abstract

Navigating the social world is an extraordinarily difficult and complex task. How do we think about other people's minds, and how do we come to infer other people's intentions from their actions? Developmental psychologists have shown that even very young infants are attuned to the emotions of those around them, imitate facial expressions and actions, and have an understanding of the concept of love. Toddlers and very young children can imitate an adult's goals instead of mimicking her actions, demonstrate empathy, and understand that other people's desires, preferences, and beliefs may differ from their own. The authors discuss recent research findings examining the developmental trajectory from infancy to young childhood of understanding other people's minds.

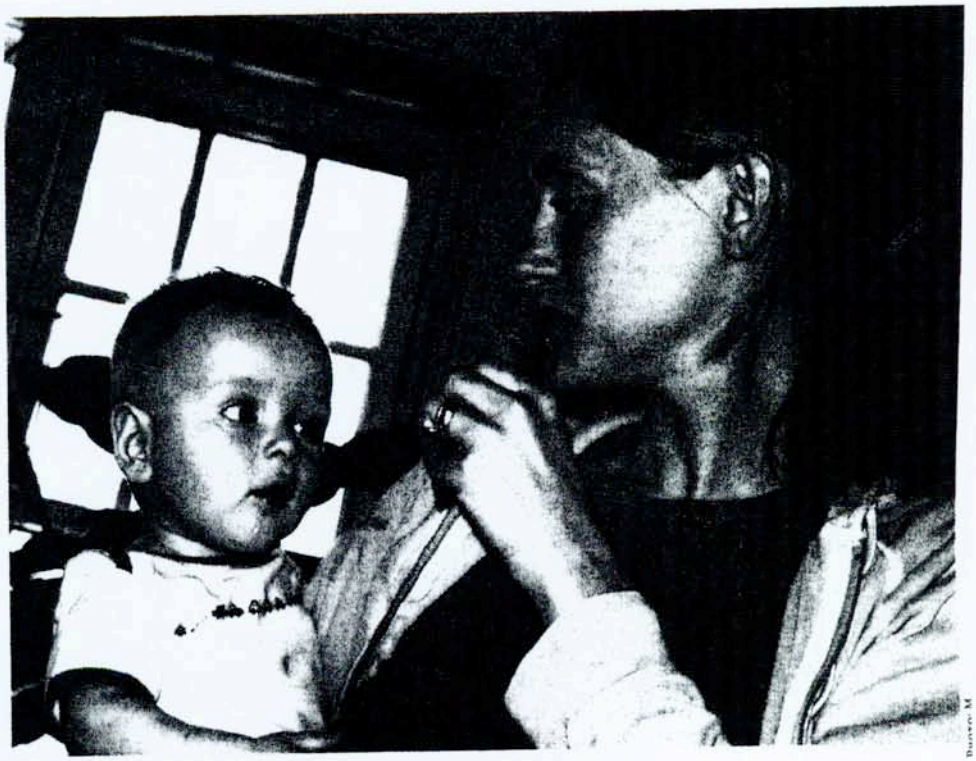
can reach for objects themselves are more likely to solve this task than those who do not, suggesting that (a) the task really does measure something about understanding goals and (b) children's own experience informs their understanding of others' minds. In fact, it seems that babies actually learn to understand the goals of others by experiencing goal-directed action themselves. You can give 3-month-old babies a chance to actually reach for objects by giving them sticky mittens—Velcro-covered gloves that they can use to pick up Velcro-covered toys. Very young babies who encounter these experiences also seem to understand the actions of others in the looking-time tasks (Sommerville, Woodward, & Needham, 2005).

Other kinds of experiments also show that a baby can link her own goals and actions to the actions of others (Needham, Barrett, & Peterman, 2002). For example, very young babies can imitate the actions of others—they will reproduce the actions they see someone else perform. But 9-month-old babies do not just imitate actions—they recognize and reproduce the results of those actions. For example, a 1-year-old baby walks into the lab and sees the experimenter tap his head on a box, which makes the box light up. One week later, the baby returns to the lab and sees the box on the table. She will immediately use her own head to get the box to light (Meltzoff, 1995).

By the time they are 18 months old, babies can imitate in an even more sophisticated way. Gergely and colleagues (Gergely, Bekkering, & Király, 2002) showed babies an experimenter touching her head to the box, but she had a blanket wrapped around her so that her hands were not available. If the other person's hands are free, the babies will tap their own heads on the machine. But if she is wrapped up in the blanket and she taps the machine with her head, the babies will instead use their own hands to tap the machine. The babies seem to have figured out that the adult would use her hands if you could, but since she cannot, she is using her head instead.

Or suppose you show the baby someone trying to dissemble a two-part toy dumbbell, as Meltzoff (1995) did. The baby sees the other person try and try again but never manage to succeed. When the baby gets the toy, he immediately pulls apart the toy himself. As all parents wryly recognize, children do not just learn by imitating successes: They learn by avoiding mistakes and understanding limitations, too. These babies go beyond simply imitating the other person. Instead, they recognize the complex causal relationship among human goals, actions, and outcomes.

At approximately 1 year old, children also start to understand that their own perceptions and attention may be shared by others. At this age, babies start to engage in *joint attention behaviors*—they will follow the gaze or point of another person, and they will point to objects themselves (Tomasello, Carpenter, & Liszkowski, 2007). They also start to understand that closing one's eyes or wearing a blindfold may make it more difficult to see (Brooks & Meltzoff, 2002).



As children grow older, they develop more and more sophisticated and complex ideas about how the mind works.

Moreover, 1-year-old babies are sensitive to the contingency patterns between their own actions and the actions of others, and they use these patterns to differentiate people and things. Psychologist Susan Johnson (2003) endowed a very clearly nonhuman thing—a sort of brown robotic blob—with the ability to react contingently to a baby. When the baby made a noise, the blob chirped; when the baby moved, the blob lit up; and so forth. A second identical blob made the same chirps and lit up the same way but did so in a way that was entirely unrelated to what the baby did (Johnson, 2003).

Then, each blob turned so that one end of it faced away from the baby and toward another object. The babies turned to follow the "gaze" of the reactive blob but not the unreactive blob. They seemed to think that the reactive blob could see. And the babies babbled and gestured more at the blob that interacted with them than at the blob that did not.

The babies also treated the reactive blob as if it had goals. Remember that babies in the Meltzoff (1995) experiment understood that a person was trying to pull apart the toy dumbbell even when they did not manage to succeed. These babies did not react the same way to a machine. But when Johnson gave the machine interactive abilities—when it chirped and lit up in response to the baby—then, the babies did act as if the machine was trying to pull apart the toy. In short, babies treated a reactive object, even a very peculiar reactive object, as if it had a mind and as if the pattern of its chirps and lights and movements were indications of what it saw and wanted to do.

Eighteen-month-olds also start to show an understanding of love, one of the most important emotions, especially for human babies. Attachment researchers (including the work of Bowlby, Ainsworth, and Main) have long noted that different babies behave differently when they are separated from their caregivers and then are reunited. Secure babies are distressed at separation but are quickly comforted when the caregiver returns. Insecure babies act differently: *Avoidant* babies seem to repress their distress—they ignore the caregiver both when she leaves and returns, and *anxious* babies are very distressed and take a long time to comfort.

A recent study actually shows that secure and insecure babies have different theories of love (Johnson, Dweck, & Chen, 2007). Susan Johnson tested 1-year-old babies first to see if they had secure or insecure attachments. Then, she did a habituation experiment. First, the babies saw an animated film of a "mother"

(a big circle moving up a sloped hill) and a "baby" (a small circle at the foot of the hill). The circles interacted like people, and at one point, the "baby" began to pulsate and a terrible real baby's cry accompanied the film. Then, the babies saw one of two outcomes. Either the mother moved down toward the baby or else she moved away from him up the slope. The secure babies expected that she would return to the baby; they looked longer at the puzzlingly unresponsive mother. The insecure babies, heartbreakingly, had just the opposite theory—they looked longer when the mother changed course and returned. In another study, Johnson found that these babies also made different predictions about what the baby circle in the video would do—secure babies predicted that he would move toward the mom; insecure babies did not make this prediction. These babies, some only 18 months old, had already learned to make predictions about love.

Understanding the Link Between Emotion and Action

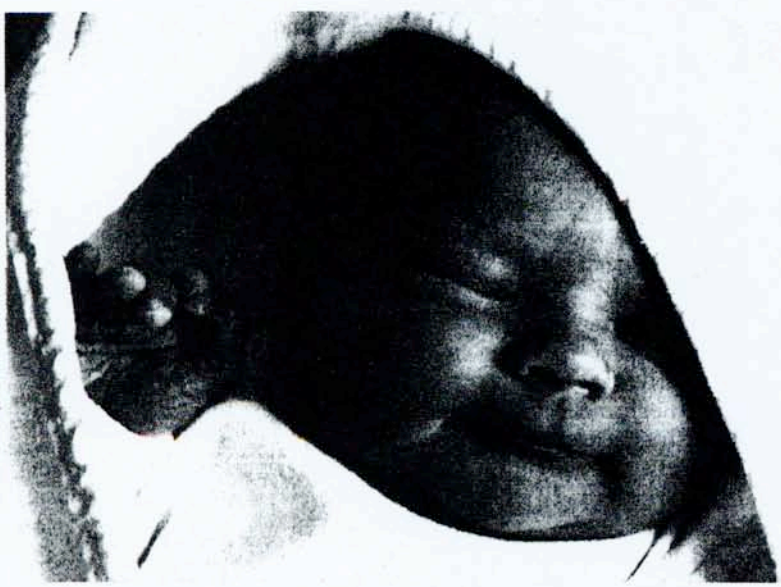
FROM AGE 2 to 6 years, children discover further fundamental facts about how their own minds and the minds of others work. They start to understand the causal connections between desires and beliefs, emotions and actions. They also start to understand that people may have different beliefs, perceptions, emotions, and desires and that those differences may lead to different actions (Flavell, 1999).

Even babies who cannot talk yet already seem to understand something about the ways that people might differ, and they can make new and surprising predictions based on that understanding (Repacholi & Gopnik, 1997). For example, we showed 14-month-olds and 18-month-olds two bowls of food—raw broccoli and Goldfish crackers. All the babies, as one might expect, loved the crackers and could not stand the broccoli. Then, the experimenter tasted a bit of food from each bowl. She acted as if she was disgusted by the crackers and happy about the broccoli. She said "eew yuck—crackers" and "mmm yum—broccoli," revealing that her tastes were the opposite of the babies'. Then, she put out her hand and said, "Can you give me some?"

The babies were a bit startled by the experimenter's perverse tastes—they waited a while before they did anything. Nevertheless, the 14-month-olds gave the experimenter the crackers. But although the 18-month-old babies had never seen anyone "crazy enough" to reject Goldfish crackers, they made the right prediction and gave the experimenters broccoli. They sweetly did what they thought would make the experimenter happy, however weird it might seem to them. The babies recognized that once you know how people's tastes work, you can do something new to make them happy.

Slightly older children can understand the complex causal interactions among desire, perception, and emotion; they can predict all the possible actions that might stem from different psychological combinations (Wellman, Phillips, & Rodriguez, 2000). In this experiment, Wellman told 2-year-olds that his friend Anne was going to get a snack of either raw broccoli or Cheerios. The scenario then proceeds as follows: Anne gets the snack in a closed box. Then, she peeks into the box and reacts (the children cannot see what she sees). When researchers ask 2- and 3-year-old children questions about this scenario, including questions about possible futures and possible pasts, the children rattle off the right answers. They know that if Anne sees the broccoli, she will be sadder than if she sees the Cheerios. If they see Anne look in the box and then say "Oh, boy," children infer that she must have seen the Cheerios; but if she says "Oh, no," she must have seen the less-desirable broccoli. But if Anne had displayed a different preference and had wanted broccoli originally, they expect her to be happy if broccoli was in the box. And if the children never saw Anne look in the box at all, they don't expect her to be especially happy or especially sad.

Finally, even older children, around 5 years old or so, start to understand the relationship between our beliefs and the world around us (Gopnik & Astington, 1988). For example, suppose you show a child a candy box that turns out to be full of pencils. The children are very surprised when they see the pencils. But if you ask them what someone else will think is in the box, 3-year-olds confidently report that the person will think there are pencils in there. The same thing can be observed in children's everyday explanations about why people do what they do. Children only start explaining actions in terms of thoughts and beliefs, especially false thoughts and beliefs, when they are around 4 years old (Leslie, 1987; Wellman, Cross, & Watson, 2001; Wimmer & Perner, 1983). For example, children say things like "The people thought that the hunchback was mean, but he was really nice." By then, children understand the deeply important fact that our ideas about the world may turn out to be wrong. It is as if young children think there is a direct causal link between the world and our thoughts about the world. Older children begin to appreciate that the link is more tangled and indirect—there are many intermediate steps between seeing the box and knowing what is inside of it, and some of those steps may go wrong.



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From the time they are born, infants already link aspects of their own minds and emotions with those of others.

Making Inferences About Others

FINALLY, TOWARD THE end of the preschool period, children begin to understand that people can have long-lasting personality traits. In a recent experiment (Seiver, Gopnik, & Goodman, 2009), we showed that 4-year-olds can infer traits from the way people act: We introduced the children to Anna and Josie, little dolls that can play on a miniature trampoline and bicycle. We showed half the children that Anna happily goes on the trampoline and leaps on the bicycle 3 out of 4 times, but Josie can only bring herself to get on the trampoline and bicycle 1 out of 4 times. We showed the other half of the children that Anna and Josie both

happily bounce on the trampoline 3 out of 4 times but only dare approach the bicycle 1 out of 4 times. The events were the same, but the statistical patterns were different.

Then, we asked the children to explain why Anna and Josie acted the way they did. The first group said that it was because Anna was brave and Jose was timid, and they predicted that Anna would continue to be brave in new situations—she would go off the diving board, too. The second group said that Anna and Josie acted that way because the trampoline was safe and the bicycle was dangerous. Watching the pattern of playground behavior can lead children to some deep conclusions about what other people are like.

Often, these inferences are correct, of course, but even very young children, similar to adults, may make profound decisions about someone's character with just a little data. You may quickly decide that a colleague is a really good guy when he smiles at you a few times (and then be startled to discover what he is really like). Sometimes, this can even be a matter of life and death. People concluded that the particular Abu Ghraib prison guards had deep-seated evil personality traits, even though psychological research suggests that many—even most—people would have acted similarly in those situations.

As we might also expect, understanding the mind also allows children to act to change the minds of others. Children who can explain actions in terms of a theory of mind also seem to be more adept, for good or ill, at altering other people's minds (Sodian, Taylor, Harris, & Perner, 1991). Children who understand minds better are more socially skillful than those who do not, but they are also better liars. They are more sympathetic, but they are better at getting under your skin, too. As any successful politician knows, understanding how people work can help you to either make them happy or manipulate them for your own ends. Four-year-olds can be surprisingly crafty politicians, especially with parents as their constituents.

Understanding minds actually also lets us intervene on our own minds. It lets us change our own minds as well as the minds of others. At about the same time that children develop a causal map of the mind, they also start to develop capacities for what psychologists call *executive control*—the ability to control one's own actions, thoughts, and feelings.

One of the most dramatic examples of executive control comes from some revealing, though rather mean, "delay-of-gratification" experiments. In the 1960s, Walter Mischel sat preschoolers down in front of two big chocolate chip cookies (or marshmallows or toys; Mischel, Ebbesen, & Raskoff Zeiss, 1972). He explained that the child could choose: She could eat just one of the cookies now, or she could get both of the cookies if she waited until the experimenter returned in 10 minutes. Most of the 3-year-olds just could not resist temptation—they gave in and took the single cookie. But by age 5, children demonstrate much more self-control.

PHOTO: MARILYN NOLT

Very young children, similar to adults, may make profound decisions about someone's character with just a little data.

One of the most interesting things about these studies was not just the fact that children got better but how they got better. One might think that children simply developed more willpower, and there is some truth to that. But, also, children got better and better at doing things to their own minds to make themselves behave differently. In Mischel's (1972) study, the successful children (i.e., those who waited to receive both cookies) put their hands over their eyes, hummed, or sang while they waited for the experimenter to return. They did much better when they tried imagining that the marshmallows were merely big puffy clouds and not tempting treats. A number of studies show that this ability correlates with our understanding of others' minds (Carlson, Mandell, & Williams, 2004). These strategies for executive control are also especially powerful evolutionary mechanisms. Imagining the different ways that we could be—and actually implementing them—lets us control and change our actions in a way that is unprecedented in evolutionary history.

Conclusion

UNDERSTANDING HOW MINDS work lets children imagine ways in which other people could act and make their goals real. But it also lets them imagine other ways in which they could act and realize their goals, too. Through developmental research studies, researchers can begin to piece together humans' evolutionary history as social creatures. Researchers find the first stirrings of social intelligence in infancy,

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where even newborns are already attuned to the minds of others and display quite sophisticated intuitions about reasons behind actions. Even simple gestures demonstrate the affection and insight that infants use to interpret other's behavior, experience empathy, and feel safe and loved. Understanding the mind lets babies and young children alter the social world around them and affect what other people do and what they do themselves, striking at the very heart of what it means to be human.

Alison Gopnik, *PhD, is a professor of psychology and affiliate professor of philosophy at the University of California at Berkeley. She is an internationally recognized leader in the study of children's learning and development and was the first to argue that children's minds could help us understand deep philosophical questions. She was one of the founders of the study of "theory of mind," illuminating how children come to understand the minds of others, and she formulated the "theory theory," the idea that children learn in the same way that scientists do. She is the author of over 100 articles and several books including* Words, Thoughts and Theories *(coauthored with Andrew Meltzoff), MIT Press, 1997,* The Scientist in the Crib *(coauthored with Andrew Meltzoff and Patricia Kuhl) William Morrow, 1999, and the recently published* The Philosophical Baby: What Children's Minds Tell Us About Love, Truth and the Meaning of Life.

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Acknowledgments

This work was supported by the James S. McDonnell Foundation Causal Learning Collaborative Initiative. The authors would like to thank Anahid Modrek for her assistance with the references.

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