Theory of Mind and Behavior

AMANDA C. BRANDONE

Abstract

The capacity to understand and reason about the unobservable mental states (e.g., thoughts, desires, and beliefs) of oneself and others, known as *theory of mind* (*ToM*), is central to human social cognition. Multidisciplinary interest in ToM stems from its potentially unique human nature, the role it plays in our ability to engage in complex social interactions, and its impairment in psychiatric and developmental disorders, such as autism. Through more than 30 years of research, we have learned a great deal about how and when children come to reason about others in terms of their mental states. This essay reviews foundational research on the development of ToM reasoning during childhood; outlines cutting-edge findings on the infant origins and neural correlates of ToM; and finally discusses key issues for future research, including reconciling infant competence with evidence of protracted conceptual development in early childhood, expanding our neuroscientific understanding of ToM and its development, and shedding light on the use and individual variability of ToM in everyday life. Pursuing these goals will address important theoretical questions and provide critical new insight into the origins, development, neural basis, and social and behavioral consequences of ToM.

INTRODUCTION

Human cognition and experience are intensely social. We spend much of our time interacting with social partners and thinking about their words, actions, and thoughts. The ease with which we engage in these processes is owed in part to our *theory of mind*.

Theory of mind (ToM; also referred to as *folk psychology* or *mind reading*) is the capacity to infer and reason about unobservable mental states, such as thoughts, desires, and beliefs, in oneself and others. This complex cognitive phenomenon encompasses several interrelated components. First, one must recognize the existence of mental states and their unique nature. Mental states are unobservable, immaterial, subjective, and sometimes inconsistent with reality. Second, one must understand how mental states come about, relate to one another, and explain behavior. Consider the case of Romeo

Emerging Trends in the Social and Behavioral Sciences. Edited by Robert Scott and Stephen Kosslyn.
 ISBN 978-1-118-90077-2.

whose *belief* that Juliet was dead (based on his *perception* of her lifeless body) and *desire* not to live without her *caused* him to take his own life.

Questions regarding the evolution, development, biological basis, and consequences of ToM have proven to be of interest in a range of fields including philosophy, primatology, and psychology (e.g., developmental, clinical, neuroscience). Interest stems from several sources. First, ToM is an important cognitive achievement underpinning our ability to engage in complex social interactions (Moore & Frye, 1991): communication, cooperation, empathy, social learning, and moral reasoning, all utilize ToM, as do less virtuous goals like deception and lying. Second, deficits or impairments in ToM have been implicated in psychiatric and developmental disorders including schizophrenia and autism. The social and communication challenges faced by people with autism provide a particularly salient demonstration of cognition in the absence of ToM (Baron-Cohen, Leslie, & Frith, 1985). Third, ToM plays prominently in models of what makes human cognition unique. Although some aspects are thought to be shared with other species, the special collection of ToM abilities in humans has been hypothesized to underlie uniquely human social cognition and cultural intelligence (Call & Tomasello, 2008). Finally, interest stems from the mystery of the basic phenomenon of ToM: How is it possible to know the minds of others when we never have direct access to the thoughts, desires, and beliefs that they contain?

This essay reviews key findings and emerging trends from over three decades of multidisciplinary research on how people come to understand their own and others' minds.

FOUNDATIONAL RESEARCH

The Classic Approach: Reasoning about False Belief

In 1978, Premack and Woodruff launched the field of ToM with the paper "Does the chimpanzee have a theory of mind?" In a commentary on that initial paper, Dennett (1978) proposed what is now considered the gold standard measure of ToM. Dennett argued that it is impossible to determine whether an individual (chimpanzee or human) is imputing the mental state of another in situations in which the other's mental state is consistent with reality or shared with the individual. A true test of ToM requires that the individual act on a mental state that conflicts with his or her own. In particular, Dennett proposed that studies should examine situations in which a subject has to make judgments about an agent who sees, knows, wants, or believes something different from himself. This proposal inspired the now classic task used to examine ToM in children (Wimmer & Perner, 1983).

Consider this scenario. A boy named Maxi has a piece of chocolate. He puts it in the cupboard and goes outside. While he is outside, his mother finds the chocolate and moves it to the drawer. Maxi returns and wants his chocolate. Where will Maxi look for his chocolate? The answer may seem obvious, but note the false belief in this situation: Maxi believes falsely that his chocolate is in the cupboard. To respond correctly, one must recognize that Maxi's mental state is inconsistent with one's own and with reality. Another commonly used procedure examines false beliefs about the contents of a container. For example, participants see a crayon box that they learn is filled with candles. They are then asked what someone who has never seen inside will think the box holds. To answer correctly, one must set aside knowledge of reality to attribute a false belief to the other person.

Studies using these and related tasks have provided a consistent pattern of results (see Wellman, Cross, & Watson, 2001 for a review). Children 4–5 years and older typically pass standard false-belief tasks by acknowledging the other person's false belief (e.g., Maxi will look incorrectly in the cupboard; the person will erroneously think the box holds crayons). Younger children, however, typically fail these tasks: they report that the character's actions and beliefs will correspond to reality (e.g., Maxi will look in the drawer; the person will think the box holds candles) failing to recognize the representational nature of beliefs. Recent meta-analyses have revealed that methodological variations to the task can make it slightly harder or easier, and that testing children who differ in cultural–linguistic community will produce slightly different ages of transition. Nevertheless, the basic findings remain the same: Children move from below-chance to above-chance performance during the preschool years (Wellman *et al*., 2001). These findings suggest that ToM undergoes a major change during early childhood (Wellman, 1990). The claim is that not until roughly age 5 do children "understand that people live their lives in a mental world as much as in a world of real situations and occurrences" (Wellman *et al*., 2001, p. 656).

Real-World Consequences of False Belief

An initial question that arises from the studies of false-belief understanding is whether the false-belief task is a meaningful measure of ToM. One way to approach this question is to examine whether false-belief performance has any measurable social consequences. Given that ToM serves as the foundation for our ability to engage in complex social interactions, performance on false-belief tasks should correspond to real-world differences in behavior. Research confirms this: Differences in false-belief understanding during preschool independently predict several aspects of social development including communicative competence, social competence, and peer interactions (see Astington, 2003 for a review). The link between false-belief performance and social behavior can also be observed in the case of autism. Children with autism perform significantly less well on false-belief tasks than control children with similar levels of intellectual disability, and show specific, disproportionate social and communicative deficits (Baron-Cohen *et al*., 1985). Finally, the ecological validity of false-belief tasks is highlighted by the fact that when children pass these tests, they also demonstrate other evidence of ToM knowledge, including talking about what people think, know, and want, appreciating the immaterial nature of mental entities, and engaging in deception and lying to manipulate others' mental states (see Wellman, 1990 for a review). Together, these findings confirm the utility of the false-belief task and the real-life consequences of ToM.

ToM Before False Belief

Another key question raised by the developmental change in false-belief performance concerns the state of ToM knowledge *before* success on the false-belief task. It is not the case that younger children have no understanding of mental states and that passing the false-belief test marks the onset of ToM. In contrast, an extensive literature suggests that children experience a sequence of conceptual insights along the path to mature ToM.

Consider first the case of understanding visual experience. Seeing is relevant to ToM because visual experience influences what we think and know, and visual perspective taking represents one form of ToM reasoning. By 2–3 years, children recognize that people with different lines of sight might see different things (Masangkay *et al*., 1974), and even toddlers show evidence of attributing visual experience to others by following an adult's gaze around a barrier to verify that they are seeing the same thing (Moll & Tomasello, 2004).

Before success on the false-belief task, children also show understanding of knowledge and its relation to experience. By 3 years, children know that perceptual experience determines what objects and events a person knows about (Pillow, 1989), and even toddlers understand something about others' knowledge states in the sense of knowing which objects others have and have not experienced (Tomasello & Haberl, 2003).

A large literature suggests that young children also show sensitivity to the desires, goals, and intentions of others. Two-year-olds understand that when people want something, they behave in a manner consistent with the fulfillment of that desire (e.g., if Sam wants his rabbit, he will search for it) and experience emotions related to that desire (e.g., Sam will be sad if he cannot find it; Wellman & Woolley, 1990). Toddlers also show some understanding of desires and their subjective nature (Repacholi & Gopnik, 1997).

The earliest evidence of ToM reasoning in children, however, comes from studies examining infants' understanding of the intentional, goal-directed nature of human action. During the first year, infants interpret human action by considering more than just its surface-behavioral properties. Early in the first year, infants appreciate that reaching actions are *goal-directed* (i.e., directed toward particular objects, not locations in space; Woodward, 1998). Later in the first year, infants also appreciate the *intentional* nature of human actions (i.e., that actions are motivated by internal causes; Brandone & Wellman, 2009). Importantly, longitudinal studies show that individual differences in attention to intentional action in infancy predict preschool ToM as measured by the false-belief task (Wellman, Lopez-Duran, LaBounty, & Hamilton, 2008). These findings suggest that intention understanding in infancy is in fact a developmental precursor of a later, more mature ToM.

In sum, evidence confirms that although success on the standard false-belief task is not achieved until roughly 4–5 years, the origins of ToM lie in infancy: Children proceed through a standard sequence of conceptual achievements along the path to false-belief understanding (Wellman & Liu, 2004)—moving from an initial understanding of the intentional nature of action to increasingly rich concepts of desire, knowledge, and belief.

ToM After False Belief

Just as success on the false-belief task does not represent the onset of ToM, false-belief performance also does not represent ToM's culmination (see Miller, 2012 for a review). Mastery of second-order false belief—the capacity to understand what one person believes (usually falsely) about another person's beliefs (e.g., I think that he thinks that there are crayons in the box; Perner & Wimmer, 1985)—occurs consistently later than the standard task at roughly 5–7 years. Beyond preschool, children also experience changes in their concepts of the nature and diversity of thought. Near age 7, children recognize that thought is characterized by a constant flow of ideas and that people are almost always thinking. At roughly the same age, children begin to demonstrate an understanding of interpretive diversity—or "an appreciation that one and the same thing can be assigned different meanings by different persons"—as in the case of the Rorschach inkblots or other ambiguous stimuli (Carpendale & Chandler, 1996, p. 1703). These achievements provide evidence of a broader understanding that the mind does not just passively receive information, but rather is active and constructive. Further evidence of the development of advanced ToM abilities can be seen in improvements with age in reasoning about complex linguistic devices such as sarcasm and irony, interpreting social faux pas, reasoning about ambiguous social scenarios, and applying an awareness of the mind toward accomplishing cognitive tasks. Thus, although ToM research has been concentrated in early childhood, it is clear that understanding ToM and its application in social situations develops throughout childhood and into adulthood.

Explaining ToM Development

There are at least two classes of variables that explain individual differences in ToM. The first includes family variables. ToM development is enhanced when the family environment draws attention to the fact that mental states exist and can vary across individuals. For example, conversations with parents about mental states, mothers' tendency to focus on their children's own mental states, and children's experience with siblings influence how quickly children meet ToM milestones (Dunn & Brophy, 2005).

Second, ToM is also related to two key cognitive constructs: executive functions and language. Executive functions are the cognitive processes involved in working memory, inhibition, and planning. At the same time that ToM abilities develop, executive functions also improve dramatically (Zelazo, Muller, Frye, & Marcovitch, 2003). There are several ways in which executive functions could be involved in ToM and the false-belief task (e.g., tracking the event sequence, inferring and holding in mind the agent's false belief, inhibiting one's own perspective, and/or reality to respond on the basis of the agent's belief), and many studies have confirmed correlations between children's ToM and their performance on executive function tasks (Carlson & Moses, 2001).

Language abilities are also intimately related to ToM development. Across studies, significant relations between success on ToM tasks and performance on language measures have been observed in typically developing children and in clinical samples, including children with autism, specific language impairment, and deafness (Milligan, Astington, & Dack, 2007). Language likely factors into ToM by supplying a vocabulary of mental state terms, providing the grammatical structure used with mental state verbs (e.g., think and know), and creating the opportunity for conversation—especially about mental states (Astington & Baird, 2005).

Several theoretical accounts have been advanced to explain the development of ToM and its relation to language, executive functions, and experience in the family. The *theory–theory* perspective claims that ToM understandings are built gradually and progressively over development, as children's naive theories about the mind are revised based on new experiences (Gopnik & Wellman, 1994). On this view, the protracted sequence of ToM achievements, including the developmental shift between 3 and 5 years in false-belief understanding, reflects a process of intuitive theory development and revision. *Simulation* theorists, in contrast, argue that we understand others' minds and actions directly by projecting ourselves into the other's situation, simulating what we would feel in that situation, and attributing that experience to the other (Harris, 1992). On this view, developmental change in ToM results from improvements in children's ability to engage in simulation. Finally, according to the *modularity* account, ToM reasoning is made possible by an innately specified module in the brain. Change thus results from biological maturation that triggers ToM concepts to "come online" and from the development of abilities independent of the ToM module, including response–inhibition and other executive functions (Leslie, Friedman, & German, 2004). Although there are clear tensions between these accounts, most researchers accept that elements of each, as well as increases in language and executive function, explain and shape the course of ToM development.

CUTTING-EDGE RESEARCH

Two emerging areas of cutting-edge research have challenged the foundational research and theoretical accounts of ToM development described above.

False Belief in Infancy

First, the classic pattern of ToM development supported by decades of research has received renewed consideration in light of new evidence that infants show understanding of false belief on some measures. For example, Onishi and Baillargeon (2005) used a nonverbal violation-of-expectation paradigm to examine 15-month-olds' response to a series of events similar to those in the classic false-belief task. In this study, an agent hides an object in one of two locations and is absent while the object moves unexpectedly to the other location. The agent then reaches into either the location where she falsely believes the object to be or the object's true location. Data show that infants look longer when the agent acts in line with reality (i.e., reaches in the object's true location), when she ought to hold a false belief. Longer looking is thought to reveal extended processing due to surprise or puzzlement. Thus, these and analogous findings have been interpreted as indicating that infants track mental representations of agents, expect them to act on false beliefs, and are surprised when they do not.

Similar results have been found in anticipatory-looking experiments that use patterns of eye movements to measure whether participants make action predictions based on agents' false beliefs. Data show that children 18 months and older make anticipatory gaze shifts, indicating their predictions about the consequences of a false belief (i.e., expecting an agent to act on a location that is sensible only if they recognize that the agent possesses a false belief; Southgate, Senju, & Csibra, 2007).

Perhaps, the most compelling evidence of early-emerging false-belief competence comes from interactive paradigms in which infants (18–24 months) interact with social partners in manners suggesting that they anticipate their partners' false beliefs. Knudsen and Liszkowski (2012) found that infants spontaneously intervene to prevent people from acting on false beliefs (i.e., by pointing to the location of an object before their partner with a false belief committed a mistake). These results suggest that infants were able to infer that the partner held a false belief, predict how he would behave given that false belief, and spontaneously help by preventing his mistake.

In sum, strong and converging recent evidence suggests that some ability to reason about false beliefs—a skill traditionally thought to emerge at 4–5 years—is actually present in infancy. The questions of how to define these infant ToM abilities, account for them theoretically, and reconcile them with the protracted developmental trajectory described previously are key issues for future research.

ToM and the Brain

Second, the ToM literature has been enriched recently through cutting-edge investigations into the neural bases of ToM. There is now substantial evidence that ToM reasoning in adults involves a network of core neural regions including the medial prefrontal cortex (mPFC), right and left temporoparietal junction (TPJ), superior temporal sulcus (STS), temporal poles (TPs), and precuneus (see Carrington & Bailey, 2009 for a review). These regions are recruited in largely overlapping ways across various paradigms and individual mental states (e.g., beliefs and desires). Moreover, these regions have been found to show less activation in individuals on the autism spectrum (Baron-Cohen *et al.*, 1999). Although questions remain about the functional contribution of each region and the extent to which these neural substrates are specialized for ToM, existing data provide a foundation for understanding how ToM reasoning is accomplished in the brain.

Recently, researchers have also begun to examine the neural correlates of ToM in children (see Bowman & Wellman, 2014 for a review). Existing studies suggest that children as young as 4 years activate similar neural regions during ToM reasoning as adults (Saxe, Whitfield-Gabrieli, Scholz, & Pelphrey, 2009). These data imply that there is developmental continuity in the network of neural regions involved in ToM. Yet, research also supports the hypothesis that neuromechanisms for ToM still develop during childhood and that functional maturation of these brain regions occurs as ToM performance increases (Sabbagh, Bowman, Evraire, & Ito, 2009). In particular, areas such as the TPJ appear to become increasingly recruited and specialized for ToM reasoning across childhood at the same time that the role of the mPFC is diminished. Developmental investigations into the neural correlates of ToM are still in their infancy and raise many important questions. Nevertheless, findings highlight the promise of neuroscientific research for shedding light on fundamental questions related to the origins and mechanisms of ToM development.

KEY ISSUES FOR FUTURE RESEARCH

Many critical questions arise out of the foundational and cutting-edge research on ToM. This essay examines three sets of issues for future research.

Reconciling Infant ToM with Traditional Approaches

First, the growing evidence of false-belief abilities in infants has required researchers to rethink their traditional findings and theoretical accounts. How might the evidence of early competence be reconciled with the protracted sequence of developmental achievements observed in classic research? Two general approaches have been proposed. One is to disregard findings from one side or the other by arguing that the infant research is not tapping real false-belief knowledge or that the conceptual changes observed during childhood merely reflect the development of inhibition or other aspects of executive functioning. Given the number of studies now supporting infant false-belief abilities and the breadth of research illustrating the real-world consequences and predictors of false-belief understanding in preschoolers, however, the argument for dismissing part of the evidence is tenuous.

A second approach is to accept both sets of findings as revealing something important and intriguing about ToM. Specifically, these two sets of findings may reflect different aspects of ToM: an implicit component that appears in spontaneous-response tasks such as those used in infancy, and an explicit component that shows up on elicited-response tasks such as the standard false-belief test (Apperly & Butterfill, 2009). On this account, infants have some implicit knowledge of false beliefs and their role in determining behavior, but this knowledge is not fully accessible to conscious awareness. A fully conscious, explicit ToM must still develop across early childhood through an extended process of conceptual development.

This approach yields several key questions for the future. First, how should implicit versus explicit ToM be defined? Common themes are that implicit knowledge cannot be articulated and is not incorporated into deliberative judgment; however, further research into the nature of these systems is necessary. Second, what are the implications of implicit versus explicit ToM for social cognition and behavior? How do these different types of ToM vary across individuals and what types of behavior do each support? Finally, what is the relation between the implicit and explicit system across development? Do these systems remain distinct or does early implicit knowledge feed into the development of explicit ToM? Further research on these issues promises to refine our theoretical accounts and expand understanding of the nature and developmental trajectory of ToM.

NEUROSCIENTIFIC UNDERSTANDING OF ToM AND DEVELOPMENT

Existing neuroscientific investigations have identified the network of neural regions involved in ToM reasoning in adults and have begun to shed light on how those networks develop across the life span. However, much remains unknown (Bowman & Wellman, 2014). First, little is known about the contribution of each region in the ToM network and the role of functional and structural connections between regions. Second, limited research has examined whether reasoning about specific mental states (e.g., belief and desire) is associated with distinct patterns of neural activity. Given that behavioral studies have shown unique developmental trajectories for different mental states, research comparing the neural correlates of distinct mental states could be particularly revealing. Pursuing these strategies will help to more comprehensively establish the brain basis of ToM.

To better understand ToM's ontogeny, further neuroscientific research is also necessary with participants from various ages (infancy through adulthood) and examining diverse ToM concepts and tasks. Neuroscientific approaches have a number of unique advantages in addressing developmental questions. First, they promise to shed light on the processes underlying ToM abilities, early in development. In particular, neuroscientific approaches may help to distinguish and explain the implicit and explicit forms of ToM observed in behavioral studies. Second, these methods enable researchers to compare adults and infants or children directly—a task that is nearly impossible in behavioral research, given differences in the measures and responses available to infants versus adults. Third, neuroscientific approaches can reveal underlying differences or changes in ToM processing that exist despite similarities in behavioral performance (e.g., when children and adults both pass standard false-belief tasks but recruit neural regions differentially to do so). Finally, as neural correlates for typical ToM development are identified, they can be compared to populations exhibiting atypical development (e.g., deafness and autism). Ultimately, further neurodevelopmental data will help us to better understand the neural correlates of ToM as well as the extent to which and how they change across development.

ToM Use and Individual Differences

Finally, since its inception, ToM research has been dominated by questions regarding when and how ToM concepts are acquired in typical development. Over the past three decades, researchers have gained considerable insight into these issues. Nevertheless, we know remarkably little about the mature ToM system, how it is used in everyday life, and how it differs across individuals (Apperly, 2011). For example, to what extent do adults rely on mental state inferences as they engage in social interactions as opposed to consulting other sources, such as social scripts? Although it is irrefutably the case that adults can represent the mental states of themselves and others, it is also true that some social interaction can occur without any ToM inferences; thus, it is important to examine the manner and extent to which mature adults utilize their ToM.

Moreover, everyday experience indicates that there is a range of ToM ability within the typical population. Some people consistently show insight into mental states and adapt their behavior accordingly, whereas others show considerably less awareness. Standard ToM tasks are of little use in measuring such differences, as they typically assess only the presence or absence of ToM concepts (Apperly, 2011). Understanding individual differences in ToM will require developing new ways to measure variance in people's ability to apply these concepts in a flexible, context-sensitive manner.

Questions of use and individual differences in ToM can also be considered developmentally. For example, Liszkowski (2013) has proposed that researchers examining the development of ToM should shift away from a model that focuses on mental state concepts to one that considers how children build and use a ToM system through everyday social interaction. Better tools for evaluating individual differences in children's ToM may also result in further understanding of both the social consequences and the predictors of ToM. Although research has generally supported associations between ToM and social behavior (Astington, 2003), more refined measures of individual differences in the ability to apply ToM concepts online may provide clearer links to social competence. Likewise, more refined measures may also shed light on developmental continuities in ToM (Wellman *et al.*, 2008) and facilitate new research on the factors in early experience (e.g., personality traits and family environment) that predict who goes on to develop superior ToM.

In sum, decades of multidisciplinary research have resulted in an impressive understanding of how people come to understand their own and others' minds. Exciting new findings on the origins of ToM in infancy and its neural correlates across development now leave us poised for further productive investigation. Pursuing these topics and expanding our models to include the use and variability of ToM in everyday life promises to provide critical new insight into ToM's nature and development.

REFERENCES

Apperly, I. A. (2011). *Mindreaders: The cognitive basis of theory of mind*. New York, NY: Psychology Press.

Apperly, I. A., & Butterfill, S. A. (2009). Do humans have two systems to track beliefs and belief-like states? *Psychological Review*, *116*(4), 953–970.

Astington, J. W. (2003). Sometimes necessary, never sufficient: False belief understanding and social competence. In B. Repacholi & V. Slaughter (Eds.), *Individual differences in theory of mind: Implications for typical and atypical development* (pp. 13–38). New York, NY: Psychology Press.

Astington, J. W., & Baird, J. (2005). *Why language matters for theory of mind*. Oxford, England: Oxford University Press.

Baron-Cohen, S., Leslie, A. M., & Frith, U. (1985). Does the autistic child have a "theory of mind"? *Cognition*, *21*, 37–46.

Baron-Cohen, S., Ring, H. A., Wheelwright, S., Bullmore, E. T., Brammer, M. J., Simmons, A., & Williams, S. C. (1999). Social intelligence in the normal and autistic brain: An fMRI study. *The European Journal of Neuroscience*, *11*, 1891–1898.

Bowman, L. C., & Wellman, H. M. (2014). Neuroscience contributions to childhood theory-of-mind development. In O. N. Saracho (Ed.), *Contemporary perspectives on research in theories of mind in early childhood education*. Charlotte, NC: Information Age Publishing.

Brandone, A. C., & Wellman, H. M. (2009). You can't always get what you want: Infants understand failed goal-directed actions. *Psychological Science*, *20*, 85–91.

Call, J., & Tomasello, M. (2008). Does the chimpanzee have a theory of mind? 30 years later. *Trends in Cognitive Sciences*, *12*, 187–192.

Carlson, S. M., & Moses, L. J. (2001). Individual differences in inhibitory control and children's theory of mind. *Child Development*, *72*, 1032–1063.

Carpendale, J. I., & Chandler, M. J. (1996). On the distinction between false belief understanding and subscribing to an interpretive theory of mind. *Child Development*, *67*, 1686–1706.

Carrington, S. J., & Bailey, A. J. (2009). Are there theory of mind regions in the brain? A review of the neuroimaging literature. *Human Brain Mapping*, *30*, 2313–35.

Dennett, D. C. (1978). Beliefs about beliefs. *Behavioral and Brain Sciences*, *1*, 568–570.

Dunn, J., & Brophy, M. (2005). Communication, relationships and individual differences in children's understanding of mind. In J. W. Astington & J. Baird (Eds.), *Why language matters for theory of mind* (pp. 50–69). Oxford, England: Oxford University Press.

Gopnik, A., & Wellman, H. M. (1994). The theory theory. In L. A. Hirschfeld & S. A. Gelman (Eds.), *Domain specificity in cognition and culture* (pp. 257–293). New York, NY: Cambridge University Press.

Harris, P. L. (1992). From simulation to folk psychology: The case for development. *Mind & Language*, *7*, 120–144.

Knudsen, B., & Liszkowski, U. (2012). 18-month-olds predict specific action mistakes through attribution of false belief, not ignorance, and intervene accordingly. *Infancy*, *17*(6), 672–691.

Leslie, A. M., Friedman, O., & German, T. P. (2004). Core mechanisms in 'theory of mind'. *Trends in Cognitive Sciences*, *8*(12), 529–533.

Liszkowski, U. (2013). Using theory of mind. *Child Development Perspectives*, *7*, 104–109.

Masangkay, Z. S., McCluskey, K. A., McIntyre, C. W., Sims-Knight, J., Vaughn, B. E., & Flavell, J. H. (1974). The early development of inferences about the visual percepts of others. *Child Development*, *45*, 349–372.

Miller, S. A. (2012). *Theory of mind: Beyond the preschool years*. New York, NY: Psychology Press.

Milligan, K., Astington, J. W., & Dack, L. A. (2007). Language and theory of mind: Meta-analysis of the relation between language ability and false belief understanding. *Child Development*, *78*, 622–646.

Moll, H., & Tomasello, M. (2004). 12- and 18-month-old infants follow gaze to spaces behind barriers. *Developmental Science*, *7*, F1–F9.

Moore, C., & Frye, D. (1991). The acquisition and utility of theories of mind. In D. Frye & C. Moore (Eds.), *Children's theories of mind: Mental states and social understanding* (pp. 1–14). Hillsdale, NJ: Erlbaum.

Onishi, K. H., & Baillargeon, R. (2005). Do 15-month-old infants understand false beliefs? *Science*, *308*(5719), 255–258.

Perner, J., & Wimmer, H. (1985). "John thinks that Mary thinks that": Attribution of second-order beliefs by 5- to 10-year-old children. *Journal of Experimental Child Psychology*, *39*, 437–471.

Pillow, B. H. (1989). Early understanding of perception as a source of knowledge. *Journal of Experimental Child Psychology*, *47*, 116–129.

Premack, D., & Woodruff, G. (1978). Does the chimpanzee have a theory of mind? *Behavioral and Brain Sciences*, *1*, 515–526.

Repacholi, B. M., & Gopnik, A. (1997). Early reasoning about desires: Evidence from 14- and 18-month-olds. *Developmental Psychology*, *33*, 12–12.

Sabbagh, M. A., Bowman, L. C., Evraire, L. E., & Ito, J. M. B. (2009). Neurodevelopmental correlates of theory of mind in preschool children. *Child development*, *80*, 1147–62.

Saxe, R., Whitfield-Gabrieli, S., Scholz, J., & Pelphrey, K. A. (2009). Brain regions for perceiving and reasoning about other people in school-aged children. *Child Development*, *80*, 1197–1209.

Southgate, V., Senju, A., & Csibra, G. (2007). Action anticipation through attribution of false belief by 2-year-olds. *Psychological Science*, *18*(7), 587–592.

Tomasello, M., & Haberl, K. (2003). Understanding attention: 12- and 18-month-olds know what is new for other persons. *Developmental Psychology*, *39*, 906–912.

Wellman, H. M. (1990). *The child's theory of mind*. Cambridge, MA: MIT Press.

Wellman, H. M., Cross, D., & Watson, J. (2001). Meta-analysis of theory-of-mind development: The truth about false belief. *Child Development*, *72*(3), 655–684.

Wellman, H. M., & Liu, D. (2004). Scaling of theory-of-mind tasks. *Child Development*, *75*(2), 523–541.

Wellman, H. M., Lopez-Duran, S., LaBounty, J., & Hamilton, B. (2008). Infant attention to intentional action predicts preschool theory of mind. *Developmental Psychology*, *44*(2), 618–623.

Wellman, H. M., & Woolley, J. D. (1990). From simple desires to ordinary beliefs: The early development of everyday psychology. *Cognition*, *35*, 245–275.

Wimmer, H., & Perner, J. (1983). Beliefs about beliefs: Representation and constraining function of wrong beliefs in young children's understanding of deception. *Cognition*, *13*(1), 103–128.

Woodward, A. (1998). Infants selectively encode the goal object of an actor's reach. *Cognition*, *69*, 1–34.

Zelazo, P. D., Muller, U., Frye, D., & Marcovitch, S. (2003). The development of executive function in early childhood. *Monographs of the Society for Research in Child Development*, *68*(3, Serial No. 27).

FURTHER READING

Apperly, I. A. (2011). *Mindreaders: The cognitive basis of theory of mind*. New York, NY: Psychology Press.

Baillargeon, R., Scott, R. M., & He, Z. (2010). False-belief understanding in infants. *Trends in Cognitive Sciences*, *14*(3), 110–118.

Bowman, L. C., & Wellman, H. M. (2014). Neuroscience contributions to childhood theory-of-mind development. In O. N. Saracho (Ed.), *Contemporary perspectives on research in theories of mind in early childhood education*. Charlotte, NC: Information Age Publishing.

Doherty, M. J. (2009). *Theory of mind: How children understand others' thoughts and feelings*. New York, NY: Psychology Press.

Wellman, H. M. (1990). *The child's theory of mind*. Cambridge, MA: MIT Press.

AMANDA C. BRANDONE SHORT BIOGRAPHY

Amanda C. Brandone is an Assistant Professor in the Psychology Department at Lehigh University. Dr. Brandone earned her PhD in Developmental Psychology from the University of Michigan in 2010 and her bachelor's degree in Psychology from Boston College. Her research has been published in numerous journals including *Child Development, Cognition, Cognitive Science, Developmental Science,* and *Psychological Science*. Dr. Brandone's work focuses on early cognitive development and the processes by which infants and young children gain understanding of the physical, biological, and social world.

Personal webpage: http://psychology.cas2.lehigh.edu/content/acb210

Lab webpage: http://www.lehigh.edu/childdevelopment

RELATED ESSAYS

Agency as an Explanatory Key: Theoretical Issues *(Sociology)*, Richard Biernacki and Tad Skotnicki

Language, Perspective, and Memory *(Psychology)*, Rachel A. Ryskin *et al.*

Mental Models *(Psychology)*, Ruth M.J. Byrne

The Inherence Heuristic: Generating Everyday Explanations *(Psychology)*, Andrei Cimpian

Delusions *(Psychology)*, Max Coltheart

Misinformation and How to Correct It *(Psychology)*, John Cook *et al*.

Insight *(Psychology)*, Brian Erickson and John Kounios

Micro-Cultures *(Sociology)*, Gary Alan Fine

Cognitive Processes Involved in Stereotyping *(Psychology)*, Susan T. Fiske and Cydney H. Dupree

Empathy Gaps between Helpers and Help-Seekers: Implications for Cooperation *(Psychology)*, Vanessa K. Bohns and Francis J. Flynn

Language and Thought *(Psychology)*, Susan Goldin-Meadow

An Evolutionary Perspective on Developmental Plasticity *(Psychology)*, Sarah Hartman and Jay Belsky

Normal Negative Emotions and Mental Disorders *(Sociology)*, Allan V. Horwitz

The Development of Social Trust *(Psychology)*, Vikram K. Jaswal and Marissa B. Drell

Herd Behavior *(Psychology)*, Tatsuya Kameda and Reid Hastie

Cultural Neuroscience: Connecting Culture, Brain, and Genes *(Psychology)*, Shinobu Kitayama and Sarah Huff

From Individual Rationality to Socially Embedded Self-Regulation *(Sociology)*, Siegwart Lindenberg