Theory of Mind

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Abstract

Everyday understanding of the social world relies, at least in part, on having a theory of mind—an understanding of how mental states such as beliefs, desires, and intentions cause human behavior. After introducing the core conceptual distinctions to frame discussion of the issues, we review a wide range of literature pertaining to the development of a range of theory of mind understandings; the cognitive, neurobiological, and experiential factors that contribute to those developments; and how the development of theory of mind affects a variety of social competencies, in typical and atypical development. Finally, we discuss various theories of theory of mind development and broader importance of theory of mind research for the field.

Keywords: theory of mind, false belief, cognitive development, cognitive neuroscience, experience

Introduction: Definition and Distinctions

Everyday experience of the social world presents a cognitive puzzle. Although the actions that others take and the outcomes that those actions bring about are objectively clear, the reasons for those actions are not. Although there many possible reasons for human actions, the most proximal ones concern actors' mental states: their intentions, beliefs, and desires. Our conceptual understanding that mental states cause observable behavior is referred to as a "theory of mind" (e.g., Wellman, 1990). Theory of mind is often called a "theory" because although we cannot see others' mental states, we hypothesize their existence and make probabilistic judgments about their specific contents based upon a range of relevant evidence. The adult theory of mind is also "representational" in the sense that we understand that the particular mental states that others hold are constrained by, but not copies of some true state of affairs (Perner, 1991). A representational theory of mind is

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the foundation of our adult-like understandings of subjectivity — that two individuals can have different desires, beliefs, intentions, or even interpretations of some particular situation (Carpendale & Chandler, 1996).

The importance of a representational theory of mind is woven into every aspect of social experience in which making sense of others' actions is paramount. For instance, a jury's ability to discern the extent to which a particular crime was intended affects whether they are willing to hold the person responsible for the act, and also the severity of the penalty they feel is appropriate to impose (see Kaplan, 2001). In dramatic arts, the intrigue and suspense of tragic and comic stories alike rely on the audience's abilities to track the subjective and varying mental states of the different characters as they develop within the story. As an example, consider the penultimate scene of *Romeo and Juliet*. On their surface, the events that unfold make little sense — Romeo appears where he was told to look for Juliet, sees her there sleeping, and then kills himself. But our theory of mind allows us to make sense of the tragedy — though we in the audience know that Juliet has taken a potion that has caused her to sleep, the forgoing events prevented Romeo from learning this information and so he falsely believes that she is dead. This situation, and many others like it in everyday life, only make sense by reasoning about the hidden internal mental states that motivate human action.

The goal of this chapter is to provide a wide, albeit necessarily incomplete, survey of the current empirical and theoretical literature investigating the origins and development of theory of mind understandings. Our approach follows the historical contours of that literature while also highlighting what we believe are important new directions for work in the field along the way. We will turn now to distinctions that we believe are important to draw that we believe set the stage for understanding the literature that is best referred to as relevant to theory of mind.

Theory-based versus immediate induction

The example of *Romeo and Juliet* is an important one because it also underscores a distinction in theory of mind reasoning that is sometimes ignored — the distinction between theory-based versus immediate induction about the contents of others' mental states (c.f., Hughes & Leekam, 2004; Sabbagh, 2004). Theory-based induction refers to the instances in which we make a probabilistic inference about the contents of another person's mental states based on our fundamentally conceptual, theoretical knowledge of how mental states arise from their underlying causes. In *Romeo's* case, our understanding of his false belief about Juliet's status comes from our theoretical understandings of how his idiosyncratic experiences would have shaped his representation of the situation and caused it to be different from the audience's own. Some of these experiences might include his experience of hearing others talk of Juliet's death and her deathly appearance in the crypt. Importantly, we can make these inferences about *Romeo's* false belief and their origins without additional information from *Romeo* himself. Without *Romeo* saying a word or shedding a tear, our theory-based inductive inferences can render understandings of *Romeo's* likely (false) beliefs about Juliet's status.

Inferences about others' mental states can also be based on information that is available in the immediate situation. Perhaps the paradigm example of this immediate mental state induction is emotion recognition — for the most part, one does not need to know anything special about a person and their idiosyncratic histories to make a reasonable judgment about the person's emotional state — instead, these inferences are made on the basis of apparent information such as facial expression, tone of voice, body posture, and so on. By immediate, we do not mean to claim that the inferences are automatic or obligatory (see Apperly, Riggs, Simpson, Chiavarino & Samson, 2006). Indeed, it seems likely that the inferences are still probabilistic ones insofar as there is no direct mapping from

a particular expression to a particular state, particularly when the information is partial or ambiguous (e.g., Russell, 2003). Nonetheless, the ways in which this kind of inference differs from the more theory-based inferences that are described above has important implications for understanding the conceptual, cognitive, and perceptual mechanisms that are likely to be involved in theory of mind reasoning.

It is very much an open question in the field as to whether theory-based versus immediate induction both rely on some underlying “theory of mind” ability, perhaps related to some basic motivation humans may have to understand others’ behaviors in mentalistic terms. In recognition of this, some researchers and theorists prefer to talk about the general project of making judgments about other’s mental states as “mentalizing” or “mindreading” while reserving the term “theory of mind” for those more circumscribed theory-based judgments (e.g., Apperly, 2010). Because the types of inferences are so different and thus likely have different cognitive and neurobiological underpinnings, we believe that it is important to maintain the distinction. Importantly, although there is a substantial literature on the development of children’s immediate inductive inferences about others’ mental states (e.g., sensitivity to gaze direction, joint attention, some aspects of prosodic understanding), we are going to be focusing our chapter on the literature tracking developmental changes in young children’s more theory-based conceptual understandings.

Cold-cognitive versus Hot-Affective theory of mind

A second, possibly related, distinction that is relevant in the literature concerns broad differences in the content of mental state inferences. In particular, Shamay-Tsoory and colleagues have argued that there are meaningful differences between the abilities required to reason about “cold” cognitive mental states (e.g., knowledge and belief) versus “hot” affective mental states (e.g., emotions) (Shamay-Tsoory, Aharon-Peretz, & Perry, 2009). Of course, there is little doubt that making inferences about others’ cognitive states has consequences that are different from thinking about emotional states. The reason to think that this distinction is related to the theory-based versus immediate distinction that we discussed above is because the tasks that are used to measure understandings of cold cognitive mental states are typically theory-based induction tasks (e.g., the false belief task, Wimmer & Perner, 1983) whereas the tasks used to measure understandings of hot affective mental states are typically immediate induction tasks (e.g., the “Reading the Mind in the Eyes task”, Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001). However, the two distinctions are at least theoretically orthogonal. Making accurate inferences about an actor’s likely emotional states sometimes requires theory-like understanding of how emotional states are expressed in contexts. For instance, upon seeing a friend receive a gift that you know does not suit them, they may feign delight despite their underlying disappointment (real-apparent emotion reference). In these cases, conceptual knowledge of the underlying causes of emotion and emotional expression are necessary to understand the reasons for the particular expression in the moment. Likewise, there are some cold-cognitive states that can be readily judged from immediately available information. For instance, whether someone is ignorant about a particular topic can be apparent from their hesitant tone of voice, their closed body posture, and other kinds of information that can be gleaned in the immediate surround (see e.g., Birch, Akmal, & Frampton, 2010). These examples illustrate the ways in which the hot-cold distinction is separable from the distinction between theory-based and immediate inferences about mental states. For our chapter, we will be focused primarily on work that covers theory-based inferences about both cold cognitive and hot affective mental states.

The Developmental Trajectory of Theory of Mind

A Historical Focus on False Belief Development

Throughout the 1980s and 1990s, research in theory of mind was largely dominated by studies of young children's explicit understanding of false belief — beliefs that for some reason do not comport with some true state of affairs. The false belief task comes in two basic varieties. In the "location change" false belief task (e.g., Baron-Cohen, Leslie, & Frith, 1985), children hear a story often acted out in a puppet show, in which a protagonist, say Sally, hides a toy in one location and then leaves the scene. In her absence, a second character (Anne) moves the toy to a new hiding place. Thus, Sally now has a false belief about the location of her toy; she believes it is where she left it, but in reality the toy is somewhere else. For the test question, children are asked where Sally thinks her toy is. In the "contents change" task (e.g., Gopnik & Astington, 1988), children are shown a box that is known to have familiar contents, such as a box of candy. Children are then shown that the box in fact contains something other than candy such as pencils. Here, children are asked what a puppet (e.g., Snoopy) who has never seen inside the box will think is inside. The idea is that children must recognize that Snoopy should look at the box and then have a false belief that the box has crayons, because he has no reason to think otherwise. These tasks assess children's explicit understanding of false beliefs because they require children to provide conscious, declarative responses (either verbal answers or non-verbal points) to test questions asked by an experimenter.

False belief research and the use of these types of tasks saw relatively intense focus for two reasons. The first is theoretical. A key feature of an adult-like understanding of mental states is that they are "representational" — they are subjective, person-specific representations of some external reality that are both based on and constrained by idiosyncratic experience. This adult-like understanding of mental states allows for the recognition that a given person's mental states can be different from another's, or different from the reality that they are supposed to represent. The false belief tasks provide an elegant, and relatively simple test of this complex adult-like understanding by asking children to recognize that someone will act in a way that does not comport with reality because of how they are mentally representing the world. For example in the location-change false-belief task, children are asked to report that Sally will look where she falsely believes the toy to be (i.e., where she left it) rather than where children know it really is. Thus, the logic of the false belief task as a diagnostic for this representational theory of mind understanding is generally considered to be compelling and clear (see Perner, 1991).

The second and perhaps more important reason is that the task seemed to give surprising results that demanded further investigation. The task is normally given to preschool-aged children from 3- to 5-years-old and this period sees rapid development in children's performance. By 5-years-old, children typically respond in line with an adult-like theory of mind. But more intriguing was 3-year-olds' tendency to systematically fail the task — instead of answering randomly (which would be expected if they were merely confused), they made consistent errors. In the location-change task, they consistently report that Sally will look where the toy is rather than where she left it and thus should believe it is. In the contents-change task, 3-year-olds report that Snoopy will think that there are pencils in the candy box, even though he has no reason to believe that. These results with 3-year-olds were surprising to many in part because of the simplicity of the task and how intuitive correct responses in the task appear to be to adults. Three-year-olds poor performance on these simple tasks also seemed inconsistent with their abilities to negotiate more naturalistic scenarios in which false belief understanding might be required (e.g., Reddy, 1991, 2007). For instance, Bartsch and

Wellman (1995, also Shatz, Wellman, & Silber, 1983) noted that at least some children even younger than 3-years-old can make contrasts between the contents of a mental state and reality in their natural language (i.e., “you think he’s sleeping but really he’s awake”). Thus, researchers investigated the question of why 3-year-olds were systematically failing the task, and what might be done to improve their performance.

A leading hypothesis was that the false belief task might be difficult for reasons besides the requirement to think about false beliefs. Specifically, the standard task has several events to keep track of, requires a modicum of linguistic understanding, and pragmatic understanding about test questions (e.g., Bloom & German, 2000; Siegel & Beattie, 1991; Westra, 2016). Wellman, Cross & Watson (2001) summarized the attempts of more than 100 studies conducted between 1983–1998 aimed at simplifying the false belief task to see whether 3-year-olds might show performance that better matched with the naturalistic data. Among the variables identified in the meta-analysis were changes to the test question, the nature of the objects that were involved, the extent to which children themselves were involved in the setup of the task, the length of the narrative, and the extent to which the task involved familiar real-world situations (e.g., deception). The meta-analysis showed that some of these modifications to the task were successful in leading children away from the “reality error” – in the location change task, they no longer had a systematic tendency to report that the protagonist would look where the object really was. Yet, there was no evidence that task modifications led to systematically correct performance in a group of children younger than around 4-years-old. It was concluded that there is a robust age effect that is not easily explained by any particular feature of the task. Rather, the authors concluded that between the ages of 3- to 5-years old, false-belief performance improves because during that time children acquire the conceptual understandings that are necessary to make explicit decisions about others’ representational mental states.

The shift that occurs in 3- to 5-year-old children’s false belief reasoning also appears to be stable across cultures. One convincing demonstration of this comes from a study by Callaghan et al. (2005) that used precisely the same methods with preschool-aged children from Canada, Samoa, Peru and India. Despite the diverse backgrounds, all groups showed evidence of a shift between the ages of 3.5- to 4.5-years-old. A similar pattern emerged in a meta-analysis that focused on the comparison of Chinese and North American children, two regions where has been substantial false belief research (Liu, Wellman, Tardif & Sabbagh, 2008). Despite many potentially meaningful cultural and linguistic differences between Chinese and North American children, the developmental timetable of false belief reasoning is very similar (see also Sabbagh et al., 2006).

Summary. Research using the false belief task has provided substance to the claim that children’s theory of mind understanding goes through an important transition over the preschool years that is relatively stable across cultures and not strongly affected the specific way in which it is tested. Accordingly, it is now common to treat the false belief task and other related tasks – such as appearance-reality tasks (Flavell, Flavell, & Green, 1983, see e.g., Rakoczy, Fiske, Bergfeld, & Schwarz, 2015 for related skills) – as a reliable measure of preschoolers’ social cognitive understandings. This reliability and validity of the false belief task has enabled researchers to probe the association between theory of mind and social competencies more broadly construed. The false belief task has also provided an avenue for investigating the experiential and neurobiological factors that are associated with theory of mind and its development. We will discuss both of these directions of research below.

Yet, it is important to note that the question of whether young preschoolers’ failures on the false belief task are truly attributable to conceptual deficits — that is, a misunderstanding of the con-

nection between beliefs and the reality that they are supposed to represent — is not settled. Similarly, the question of whether preschoolers' changing performance on false belief tasks is attributable to conceptual changes also remains unsettled. The controversy has largely resurfaced over the last decade due to findings from false-belief studies with infants, which we will turn our attention to now.

Implicit False Belief: new debates and controversies

The distinction between implicit and explicit understandings is a complicated one that is often defined more in terms of the response modalities than in terms of the underlying character of the knowledge represented (Dienes & Perner, 1999). A task is considered to be an “explicit” one when responses are declarative and are taken to result from decision making processes in response to some test question. Explicit responses can be verbal or non-verbal (pointing or labeling) but are generally communicative and intended to be answers to the experimenter's questions. An “implicit” task reflects non-declarative, obligatory natural responses to ongoing scenes. For example, an implicit task might monitor gaze to look for evidence of either surprise (when some event violates an expectation) or predictive looking, either of which can be based on some putative conceptual understanding that is isolated by the experimental design. The crucial difference between these response modalities is that explicit tasks are thought to require not just the conceptual understandings but also the cognitive resources that are necessary for decision making in the moment. Implicit tasks do not make these same additional demands. In the present context, implicit tasks provide an opportunity to reopen the question about whether children fail “explicit” false belief tasks because they lack the conceptual understandings or because they lack the sufficient domain-general cognitive resources to negotiate the complications of the task.

There is now ample evidence suggesting that young infants accurately predict others' behaviours in false belief type scenarios when their predictions are assessed more implicitly (see e.g., Baillargeon, Scott & He, 2010; Heyes, 2014 for reviews), potentially undermining the conclusion that 3-year-olds fail false-belief tasks due to conceptual deficits. A pioneering study by Onishi and Baillargeon (2005) used the violation-of-expectation methodology in which 15-month old infants were familiarized with a scene where an agent hid an object in one of two locations. The object then moved to an alternative location, either while the agent was observing (true-belief condition), or while she was unable to see the object's movements (false-belief condition). Looking times were measured while infants observed the agent reaching to either the outdated or current object location. In false belief conditions, infants showed evidence of surprise when the agent searched where the object really was, thereby suggesting that they expected the actor to act in accordance with their false belief. Similar findings have been reported with younger children, (e.g., Kovacs, Teglas, & Endress, 2010; Surian, Caldi, & Sperber, 2008), and with infants in implicit paradigms other than violation-of-expectation, such as predictive looking (e.g., Southgate, Senju & Csibra, 2007; Surian & Geraci, 2012). Positive findings have also been reported for implicit versions of contents-change false belief tasks (e.g., Scott & Baillargeon, 2009).

The strong interpretation of these findings is that even young infants have some very early emerging understanding — if not innate (e.g., Leslie, Friedman, & German, 2004) — understanding of false belief that is masked in studies that require an explicit response because of the peripheral cognitive demands that are required to negotiate those tasks. To date, there is no obvious reason to doubt that implicit measures can show that infants make accurate predictions in false-belief scenarios. Nonetheless, there is considerable debate as to best resolve the puzzle of why young infants

appear to show competence with false belief reasoning in implicit tasks while 3-year-olds do not in explicit tasks. We will return to this question where appropriate throughout the rest of this chapter, as there are many sources of evidence that can bear on the question. Broadly, for those who do not subscribe to the strong interpretation of the infant data, it remains possible that the mechanisms underlying performance on the infant false belief tasks are fundamentally different from those that underlie preschoolers' performance. There have been two general approaches to characterizing how those mechanisms might differ: one focuses on domain-general accounts of infants' false belief performance, and another posits two distinct systems for making judgments about others' mental states. We will discuss each in turn.

Domain-general accounts of infant false belief. One argument is that infants' responses in the violation-of-expectation or predictive looking tasks might be attributable to the dynamics of domain-general cognitive processing (e.g., Heyes, 2014; Sabbagh, Benson, & Kuhlmeier, 2013). For instance, Heyes (2014) reviews the findings of 20 separate studies purporting to demonstrate false belief reasoning in infancy, and demonstrates how each might be better explained by infants' attention being captured by contextual novelty. Others (e.g., Ruffman, 2014) have argued that processes associated with episodic encoding might lead children to encode generalized behavioral rules about what typically happens in everyday situations (i.e., "People typically look for things where they last left them"). Of course, much more research needs to be done to determine whether these domain-general mechanisms can provide a full accounting of infants' performance in implicit false belief tasks. Nonetheless, what is notable about these accounts is their attempt to account for performance in the infant paradigms without reference to psychological understandings whatsoever. If proven to be true, then there may be little continuity between infants' understanding and the developments that occur during the preschool years.

The dual-system account. A second possibility is that infants are performing a kind of psychological reasoning, but it is one that is limited to a relatively circumscribed set of situations. This possibility is sometimes called the "dual-systems" account (see e.g., Apperly & Butterfill, 2009; Low, Apperly, Butterfill, & Rakoczy, 2016). The two systems proposed include a early emerging one that registers "belief-like states" in a fast, efficient, but stereotyped manner and a second later-emerging one that computes beliefs, *per se*, but does so more slowly and requires domain-general cognitive resources that are necessary to maintain a changing, flexible representation of others' minds. The specific claim is that infants' looking patterns in the implicit false belief tasks may be attributable to the fast system while preschoolers may be relying on the slower one to make their explicit responses. This general model has catalyzed a small but burgeoning body of research that is aimed at better understanding the different characteristics of the fast and slow systems, and particularly the "signature limitations" of the fast system (see e.g., Low & Watts, 2013; Schneider & Low, 2016) and the cognitive costs of the slow system (e.g., Apperly, Back, Samson & France, 2008). What is important, however, is that this model conceptualizes infants' performance in the false belief task as relying on fundamentally mentalistic concepts, which might then be continuous with subsequent understandings that emerge later in development.

Summary. In laboratory tasks that rely on implicit responding, infants show evidence that they expect people to act in accordance with false beliefs. More work needs to be done to characterize both whether and how the cognitive underpinnings of infants' performance in implicit false belief tasks differs from those supporting preschoolers' performance in explicit false belief tasks. We see this as an exciting area for research in the field and one that recognizes the remarkable findings that continue to appear in the infant literature, while still acknowledging the importance of the devel-

opmental achievements over the preschool years that have been demonstrated by years of careful research.

Beyond False Belief: Understanding Other Mental States

An understanding of mental states is not limited to an understanding of false beliefs. The ability to make sense of and predict others' behavior involves understanding multiple interconnected mental states. To take a simple example, we can understand the action of going to the refrigerator for milk as a behavior that is motivated by a belief that the milk is in the refrigerator, and a desire for milk; we would predict a different behavior if we knew someone thought there was milk in the refrigerator but did not desire it. The role of multiple mental states becomes even more apparent when we consider not just simple actions with objects, but interactions with others. Our ability to successfully strategically collaborate, negotiate, or compete with others benefits when we are able to give full consideration to others' intentions, desires, knowledge, and beliefs (Tomasello, 2014). Though the cognitive and conceptual mechanisms underlying our abilities to reason about intentions, desires, and knowledge may be different from that underlying an understanding of beliefs and false beliefs, an understanding of these additional mental states is nonetheless critical to our everyday social reasoning (Wellman, 2014).

This broader view suggests that the developmental trajectory of theory of mind understandings has its origins in early social perception. By 3 months of age, infants follow another's eye gaze (e.g., D'Entremont, Hains, & Muir, 1997; Moore, 1999) and engage in joint visual attention in social contexts (e.g., Corkum & Moore, 1998; Deák, Flom, & Pick, 2000). These abilities demonstrate a sensitivity to others' attention and to the perceptual information available to others, which may in turn be important for constructing an understanding the connections between the observable world and internal mental states. In this section we will cover how, over the first two years of life, infants' understanding advances from initial sensitivities to the links between action and intention, to more solid conceptions of person-specific desires, and to an understanding of the connections between prior experience and states of knowledge/ignorance. These conceptual advances are part of the larger developmental framework for an adult-like representational theory of mind.

Understanding Intentions. By as young as 6-months-old, infants already seem to possess some understanding that others' actions are motivated by underlying intentions and goals. For example, after habituating to an agent's hand reaching for and grasping a teddy bear on the left-side of a stage, 6- and 9-month-olds look longer when the hand keeps the same path of motion (reaching to the left) but demonstrates a distinct goal (grasping a ball instead of a teddybear) (Woodward, 1998). These results suggest that infants encode others' actions in terms of their intended goal, and not simply in terms of specific paths of motion. The ability to encode actions as goal-directed is also evident in infants' imitative behavior: 7-month-olds selectively imitate an experimenter's actions when the experimenter has a clear, intended goal (e.g., grasp an object), but do not imitate actions that do not have clear goals (e.g., touch object with back of hand) (Hamlin, Hallinan, & Woodward, 2008; Thoermer, Woodward, Sodian, Perst, & Kristen, 2013).

By 10–12 months, infants understanding of intentions begins to become separate from observable actions such that they can impute the intentions behind 'failed' actions as well (Brandone & Wellman, 2009). For example, after habituating to a scene in which an agent reached in an upward arc over a tall barrier to almost touch but never fully retrieve a ball, infants looked longer when viewing the agent reach in a similar upward arcing path of motion when the barrier was removed than when viewing a direct reach toward the ball (which was now possible given the lack of barrier).

This looking pattern suggests that by the end of the first year of life, infants are able to encode others' actions in terms of their underlying goals (e.g., to retrieve a ball), even when the goal itself is not fully demonstrated.

A substantial literature has built up around specifying the conditions under which children appear to impute intentions and goals to actors in simple situations (see e.g., Robson & Kuhlmeier, 2016 for a recent review). Of these, perhaps one of the most intriguing concerns whether the action or goal that is being observed is one that can also within infants' own action repertoires. For instance, infants who cannot themselves grab objects also appear to have difficulty attributing grasping intentions to others (e.g., Falck-Ytter, Gredebäck, & von Hofsten, 2006; Kanakogi & Itakura, 2011). Intriguingly, however, children's abilities to attribute intentionality to an action can change rapidly with their own experience. In a series of remarkable studies by Sommerville and colleagues (e.g., Sommerville, Woodward, & Needham, 2005), 3-month-olds who were unable to grasp objects were given experience with Velcro mittens that allowed them to "grasp" Velcro objects around them. Although they did not show evidence of intention attribution prior to this experience, they did after the experience when shown an actor wearing those same gloves. These findings, and others like them, show that from very early, infants have the capacity to interpret others' actions as intentional, but that those attributions are constrained to intentions that are within the infants' own action repertoire. By the end of the first year, infants come to take a broader, criterion based view of what kinds of actions (and from what kinds of agents), are intentional (e.g., Shimizu & Johnson, 2004).

Understanding Desires and the Subjectivity of Mental States. At the end of the first year of life, infants also begin to understand actions in terms of their underlying desires. After viewing an agent express desire for a specific toy (e.g., smiling and happy speech toward a particular toy), 12-month-olds look longer when the actor picked up a different toy for which the agent expressed no previous desire, suggesting infants expect others' actions to be based in desires (Phillips, Wellman & Spelke, 2002). A few months into the second year of life, infants' understanding of intentions and desires incorporates an understanding that that mental states are person-specific and subjective. For instance, by 12-14 months, infants will follow an agent's gaze around a barrier, even if this requires the infant to lean or move behind the barrier, suggesting the infant understands that the agent may see something they themselves do not see (Moll & Tomasello, 2004). By 18 months, infants can apply this understanding of subjective experience to others' desires as well: When given a choice to offer an experimenter one of two snacks, 18-month-olds will offer the experimenter the snack for which she previously expressed desire (i.e., said, "Mmm, Yummy!" after eating broccoli) even if the experimenter's desire contrasted with the infants' desire for the alternate snack (i.e. infant prefers crackers over broccoli) (Repacholi & Gopnik, 1997). These findings demonstrate that toddlers can recognize that desires are subjective and distinct; that they are specific to individuals and can sometimes contrast with the infants' own. What is perhaps most intriguing about these findings is that the understanding that two individuals can have different desires regarding some particular state of affairs emerges well in advance of their understanding that two individuals can have different beliefs about the same. Findings such as these help focus our understanding of what specifically develops over the preschool years — namely, it is not the understanding of subjectivity, per se, but rather the understanding of how subjectivity applies to a range of mental states.

Understanding Knowledge and Ignorance. There is also evidence to suggest that infants understand something about the mental states of knowledge and ignorance. Twelve-month-olds notice when an experimenter's prior experience would make them knowledgeable or ignorant about the location of an object and are more likely to point for the experimenter's benefit when she is ignorant

(Liszkowski, Carpenter, & Tomasello, 2008). Twelve- and 18-month-old infants can also correctly identify an object whose presence an experimenter was previously ignorant of (Tomasello & Haberl, 2003). After playing together with two specific objects, when a third object was introduced to the infant in the experimenter's absence, the infant gave the experimenter the novel toy when the experimenter returned and exclaimed "Wow! Cool! Can you give it to me?" These findings reveal that around children's first birthday, they are sensitive to the factors that can make a particular item or situation novel from one person's perspective even if it is not novel from their own perspective. Thus, similar to their understanding of desires, by the end of the first year of life infants show some nascent appreciation of the person-specific nature of mental states.

Developmental Progression from Desire to Belief Understanding. As was apparent in the foregoing discussion, there is now strong evidence of a developmental progression from an early understanding of desires to a later explicit understanding of beliefs and thoughts. For some time, the progression was difficult to pin down experimentally because the tasks used to measure desire and belief understanding were different in a number of ways. Additional evidence comes from their natural language; although children use desire words (e.g., 'want', 'like') and can predict that storybook characters will act according to their desires by around age 2 years, it is not until around 3 years of age that they use belief words (e.g., 'think', 'know') and consistently make predictions for characters based on beliefs (Bartsch & Wellman, 1995). Moreover, the desire-belief progression holds across tasks that are carefully matched on procedural methodology, linguistic structure, and materials (e.g., Wellman & Liu, 2004).

One outcome of this research has been the construction of a "theory of mind scale" that can assess children's achievements of various conceptually relevant milestones that emerge prior to false belief understanding (Wellman & Liu, 2004). In addition to its growing use as an assessment tool for research purposes, research using the scale has shown that the order in which children acquire the milestones tends to be fairly stereotyped within a given population. However, there are some relevant cross-cultural variations in the order in which milestones are acquired (e.g., Wellman, Fang, Liu, Zhu, & Liu., 2006; Shahaeian, Peterson, Slaughter, & Wellman, 2011). In brief, children growing up in cultures emphasizing collective knowledge and dispute avoidance such as China (Wellman et al., 2006) and Iran (Shahaeian et al., 2011) understand knowledge and ignorance in others before they understand the person-specific nature of beliefs; whereas children growing up in cultures emphasizing individuality and diverse opinions such as the U.S. (Wellman & Liu, 2004), Australia (Shahaeian et al., 2011), and Germany (Kristen, Thoermer, Hofer, Aschersleben, & Sodian, 2006, as cited in Wellman, 2014) understand the person-specific nature of beliefs prior to understanding knowledge and ignorance. However, the progression of understanding desires before beliefs appears especially robust: it is consistently evident across each of these countries and cultures.

An intriguing question concerns why an understanding of desires might develop prior to an explicit understanding of beliefs. One possibility is that beliefs are especially difficult is because they require representing not just the contents of someone else's mental states, but also the relationship that those contents are supposed to bear with respect to some true state of affairs (Perner, 1991; Wellman, 2002). For example, someone can believe they left a bag of apples in the car, while someone else can believe the apples were left on the kitchen counter. At least one of the individuals' beliefs will be wrong because there is some true state of affairs that the belief is supposed to represent. Desires, on the other hand, do not have the same requirement; one person can like broccoli while another likes goldfish and yet, no one desire is right or wrong. Perner (1994) expresses the difference as one of "thinking of" versus "thinking that." One can think of oneself being on a

beach without causing any representational conflict. However, if one were to think that one was on a beach when in fact one was in their dreary office, this would indeed be cause for concern. Some researchers have called this additional requirement “metarepresentation” because it involves thinking not just about the contents of a mental state but also the specific way in which those contents are supposed to represent reality (see Perner, 1991). Belief-reasoning may develop later than desire-reasoning because additional cognitive or computational capacities may be required to understand the metarepresentational nature of beliefs, and these capacities may not exist until later in development.

Summary. Theory of mind development begins well before the emergence of explicit false belief understanding. Children’s early understanding of intentions, desires, and knowledge are sophisticated insofar as they incorporate an understanding that the contents of these mental states can differ across people, relative to their specific experiences and proclivities. There is a specific developmental progression by which these understandings emerge from infancy through the preschool period — understandings of motivational mental states such as desires and intentions emerge and become more sophisticated prior to equivalent understandings of epistemic mental states such as knowledge and beliefs. More work is necessary to better understand why this developmental progression exists, but there are reasons to think that epistemic mental states (beliefs in particular) have unique conceptual complexity.

Theory of Mind Development in Middle and Late Childhood

Just as theory of mind reasoning does not begin with false belief understanding, so too does it not end there. Performance on standard false-belief tasks (e.g., the location-change and contents-change tasks described in the section on false-belief development above) typically reaches ceiling shortly after 5-years-old (e.g., Wellman et al., 2001). Perhaps because of this methodological issue, investigation of theory of mind in school-aged children and adolescents is still quite limited. Some researchers have used “second-order” false-belief tasks in which participants are required to reason not just about a person’s belief, but about a person’s belief about someone else’s belief or other mental state (e.g., Sally thinks that Anne thinks that the toy is in the basket; John thinks that Mary is happy to see him) (Perner & Wimmer, 1985). Most children fail these second-order tasks prior to 7 years of age (Miller, 2009). Third- and fourth-order false-belief tasks (e.g., Sally thinks that Anne thinks that Mary is in the kitchen) are even more challenging. The increasing difficulty of the task demands can yield individual differences in performance into late childhood and adolescence (Liddle & Nettle, 2006).

Critically though, the achievement of belief and false-belief reasoning, even as assessed in more challenging tasks, does not equip children with all that is necessary to understand the nuanced connections between minds and everyday behaviour. To accurately predict and make sense of human action and interaction, it is important to also understand how different mental states interact and mental states can be affected by time and context. Assessments of these richer, more flexible mental-state understandings reveal developmental advancements extending beyond preschool, into middle and late childhood and adolescence (Lagattuta, et al., 2015 for review).

Understanding Interactions Between Mental States. Children’s understanding of how different mental states interact with each other to affect behaviour emerges after children enter school. For example, Sayfan and Lagattuta (2008) asked preschoolers, school-aged children, and adults to predict and explain the emotions of infant, child, and adult protagonists in threatening situations (e.g., encountering a snake). Accurate responses required taking into account the amount

of knowledge that each type of protagonist would have about the situation. Adults and school-aged children, but not preschoolers, were able to consider that more knowledgeable protagonists (e.g., adults) who understood the threat, would be more fearful than less knowledgeable protagonists (e.g., infants and children) who may not know that a given situation is threatening.

“Interpretive” theory of mind tasks also require participants to reason about others’ mental states based on their idiosyncratic knowledge (e.g., Carpendale & Chandler, 1996). In these tasks, participants are asked to predict how different individuals will interpret a picture that is partially occluded based on the individuals’ prior experience and knowledge of the image (e.g., What will Sally and Anne each think this is a picture of, given Sally never saw the unoccluded picture but Anne did). These tasks are particularly challenging because they require participants to construct different beliefs for different individuals. Children do not typically pass these tasks until 6-7 years old and performance continues to improve into adulthood (Lagattuta, Sayfan, & Blattman, 2010; Lagattuta, Sayfan, & Harvey, 2014; Ross, Recchia, & Carpendale, 2005).

Over middle childhood, children also come to understand the influence of peoples’ thoughts on their emotions. Between 5- and 10-years-old, children progress in their understanding that even though two people might feel the same way about a given negative situation, subsequent thoughts can affect the intensity of those feelings. For instance, children might judge that two children who break their arms will be sad, but the one who sees a bright side (e.g., “all my friends can sign my cast”) will feel less sad than someone who dwells on the negative aspects (e.g., “my arm will be itchy”) (Bamford & Lagattuta, 2012). These findings nicely illustrate ways in which children’s theory of mind understandings, *per se*, become increasingly mature over middle childhood.

Mental-State Reasoning in Context. Older children also begin to consider aspects of the current context that can inform judgments about the underlying intentionality of peoples’ actions. One nice example of this is the “Faux Pas” task in which children are told stories in which a character accidentally says something to another character that is potentially offensive or mean given what children know about the context (Baron-Cohen, O’Riordan, Stone, Jones, & Plaisted, 1999). For instance, in one story, a woman just moved into a new house and bought new curtains. Her friend visited later that day for the first time and insults the curtains, saying, “Oh those curtains are horrible! I hope you are going to get new ones!” The ability to understand both that the utterance would be offensive and that the offender did not intend harm develops over 5 to 11 years old (Banerjee & Watling, 2005; Baron-Cohen et al., 1999).

Summary. Much of the complexity of human interaction relies on sophisticated theory of mind understandings that are built on the insights that are achieved during the preschool years, but also go well beyond them. In particular, during the school years, children come to increasingly appreciate the intertwined nature of mental states and how they are affected by context. There are surely more aspects of a sophisticated adult-like theory of mind that continue to develop into adolescence (see e.g., Chandler, 1992). An important direction for future research in this area is delineating those areas and establishing through individual differences studies whether they make important contributions to children’s abilities to successfully navigate the increasingly complex social worlds that they inhabit as they get older.

Factors that are associated with Theory of Mind development

For the remainder of the chapter, we are going to describe work that details what is known about the cognitive, neurobiological, and experiential factors that affect theory of mind development. Much of this work is focused on the transitions that occur during the preschool years, and so on the

factors that affect false belief understanding. Thus, we will be returning our attention to that age group and revisiting some of the issues that arose during our prior discussion. We do ask, however, that the reader bear in mind that although the most is known about the false belief task, we believe that a critical direction for future research is understanding more about the factors that affect the developments that occur both before the false belief milestone.

Executive functioning and Theory of Mind

Executive functioning is the term used to refer to the broad suite of interrelated domain-general cognitive skills that are necessary for goal-directed action, including working memory, set shifting, and inhibitory control (Zelazo, Carlson, & Kesek, 2008; Garon, Bryson, & Smith, 2008). There are several reasons to believe that executive functioning skills would be important for correct performance on theory of mind tasks, and false belief tasks in particular (Frye, Zelazo, & Palfai, 1995; Hughes, 1998; Russell, 1996). For instance, in the location change false belief task, children have to watch a story in which a character returns to a scene and is looking for an object that has moved in her absence. Children's natural tendency might be to simply tell the story character where her toy is, and so inhibitory control is necessary to overcome this prepotent tendency and answer the test question. Similarly, it is natural and habitual to tell others (by pointing) where objects truly are, and so inhibitory control may be required to make the non-canonical response to point to a location where something is not (Carlson, Moses, & Hix, 1998). In a separate analysis, Frye and colleagues (1995) suggest that the structure of a false belief task is similar to a set shifting task like the dimensional-change card sorting task (DCCS).

There are now two lines of evidence showing that executive functioning is associated with false belief reasoning. The first and more extensive line takes an individual differences approach in which children's performance on a battery of tasks that measure executive functioning is associated with performance on a false belief battery (e.g., Carlson & Moses, 2001; Hughes, 1998). This work has consistently shown that executive functioning skills are moderately correlated with false belief performance (see Devine & Hughes, 2014, for a meta-analysis). The correlation between executive functioning and false belief is typically higher for "response-conflict" executive functioning tasks (e.g., Stroop-like tasks) that require children to choose between one of two competing responses based upon a novel task rule than it is for "delay" tasks that simply ask children to withhold a response for some time (Carlson & Moses, 2001). Some have suggested that this preferential relation is because response-conflict tasks combine component executive functioning skills in much the same way that false belief tasks do (Hala, Hug, & Henderson, 2003).

The second line of evidence comes from research showing that experimentally titrating the executive demands of the false belief task has predictable effects on children's performance. For instance, children's performance on the location-change false belief task improves if the object is moved to a location away from the immediate scene (Wellman et al., 2001), presumably because taking the object away weakens children's prepotent tendency to inform the character about the true location of the object. Similarly, other studies saw improved performance in preschoolers by asking children to respond to the test question in a novel way (e.g., using a cardboard arrow), which likely reduced the need for children to overcome the prepotent tendency to point to where something really is (Carlson et al., 1998; Coullard & Woodward, 1999). On the other side, even older children's performance can be worsened by increasing the executive demands of the task. Careful work by Friedman and colleagues (e.g., Friedman & Leslie, 2004) showed that adding another location worsens children's false belief performance, likely by increasing the complexity of the decision they

have to make. The same is true for older children; theory of mind reasoning is negatively affected by task modifications that increase the load on executive functioning (Qureshi, Apperly, & Samson, 2010).

It is clear that false belief tasks have executive functioning demands, and so having a modicum of executive functioning is certainly necessary for children to demonstrate false belief understanding. Yet, from a developmental perspective, there is burgeoning evidence that although executive functioning skills may be necessary, they are not sufficient for preschoolers' false belief reasoning. Several studies now have shown that preschool-aged children in these cultures are advanced in their executive functioning skills relative to their North American counterparts. In one study by Sabbagh et al. (2006), 3.5-year-old Chinese children performed as well on a battery of executive functioning tasks as 4-year-old North American children. Yet, despite this substantial advantage in executive functioning, the Chinese preschoolers showed no parallel advantage in false belief reasoning. The same pattern has been replicated in China (Tardif, Wellman & Cheung, 2004) and with Korean children (Oh & Lewis, 2008). These findings and others (see e.g., Benson & Sabbagh, 2009) demonstrate that although executive functioning skills may be necessary for false belief reasoning, they are not themselves sufficient.

It can be noted that these findings regarding the specific association between executive functioning and preschoolers' false belief development have implications for common interpretations of the infant implicit false belief findings. Recall that the findings with infants have led some to conclude that even young infants have the capacity for false belief understanding but that the explicit tasks that are used with 3-year-olds mask those capacities because of their peripheral cognitive demands. The findings with executive functioning speak against this strong interpretation, at least as it pertains to the peripheral executive functioning demands of false belief tasks; there are groups of children who have relatively advanced executive functioning skills yet still have difficulty with explicit false belief tasks (see Low et al., 2016; Sabbagh et al., 2013).

There is also evidence to suggest that executive functioning is important for developing mental state understanding (see Moses, 2001; Moses & Sabbagh, 2007). Longitudinal studies have shown that individual differences in 3.5-year-old children's EF skills are a unique longitudinal predictor of preschoolers' false belief reasoning a year later (e.g., Hughes, 1998; Carlson, et al., 1998; Flynn, 2007, see also Devine & Hughes, 2014). More recently, there is evidence that among 3.5-year-olds who fail false belief tasks, individual differences in executive functioning predict the extent to which those children benefit from a training regimen designed to promote false belief reasoning (Benson, Sabbagh, Carlson & Zelazo, 2013). These findings show that in addition to being important for negotiating task demands, EF may play a causal role in children's acquisition of the conceptual understandings necessary for false belief reasoning.

Summary. The findings detailing the association between theory of mind and executive functioning in preschool aged children clarify both that false belief tasks have executive functioning demands that affect children's performance, and also that immature executive functioning is not the only reason for 3-year-olds failure at false belief tasks. These findings support the view that conceptual developments that occur over the preschool years are critical to children's abilities to reason about the representational nature of mental states. There is also now evidence to suggest that executive functioning skills may play a causal role in the process of acquiring theory of mind concepts from experience.

Neural bases of theory of mind development

The cross-cultural synchrony in the broad trajectory of theory of mind development suggest that its broader parameters might be established by relatively specific neurobiological factors that may also change rapidly over the first 5 years of life. In adults, representational theory of mind understanding is associated with a distinct set of neural regions, including the right temporal-parietal junction (rTPJ), the precuneus (PC), and the dorsal medial prefrontal cortex (dMPFC) (see Koster-Hale & Saxe, 2013 for a recent review). There is now substantial evidence suggesting that the same is true for young children.

Functional and structural brain development. A study using source localized EEG methods showed that the functional maturation of these areas that are associated with false belief reasoning in adults, in particular the rTPJ and the dMPFC, was positively associated with performance on a theory of mind battery in young children (Sabbagh, Bowman, Evraire, & Ito, 2009). That is, children with more evidence of functional maturation in these regions showed better performance on the false belief task and other similar tasks. A similar pattern of results has been shown using fMRI methods (e.g., see Gweon & Saxe, 2013). What is perhaps most interesting about these findings is that they suggest that the theory of mind network supports children's performance on these tasks, rather than areas that are important for domain-general cognitive skills (e.g., executive functioning). These findings, though interesting in their own right, also further suggest that changes in theory of mind reasoning, per se, is the critical factor underlying transitions in preschoolers' performance on theory of mind tasks.

The importance of the functional recruitment of the prefrontal cortex in preschoolers' theory of mind reasoning has also been shown in a handful of event-related potential (ERP) studies (see Sabbagh, 2013 for a review). For instance, Liu and colleagues (Liu, Sabbagh, Gehring, & Wellman, 2009) showed that 6-year-olds who could pass a relatively complicated false belief task showed a left-lateralized frontal late slow wave (LSW) effect as they responded to test questions. Intriguingly, children who were the same age but did not pass the tasks did not show that same effect, thereby suggesting that the recruitment of regions of the frontal lobe, perhaps especially the medial prefrontal cortex, is associated with good performance on theory of mind tasks. The left-lateralized LSW effect has been associated with reasoning about beliefs in 6- to 8-year-old children (Meinhardt, Sodian, Thoermer, Döhnel & Sommer, 2011) and in 8- and 9-year-old children (Bowman, Liu, Meltzoff, & Wellman, 2012), all using slightly different paradigms. Taken together, these findings provide converging evidence that changes in theory of mind reasoning are associated with the functional maturation and recruitment of relatively discrete neural systems within the medial prefrontal cortex.

What is particularly intriguing about the medial prefrontal regions is that they appear to be important not only for reasoning about beliefs but for desires as well. Work by Bowman and colleagues using event-related potentials (Bowman et al, 2012) showed that school-aged children's desire and belief reasoning were associated with mid-frontal activity but only belief reasoning was associated with activity at right parietal sites, near the rTPJ. The association between the rTPJ and school-aged children's reasoning about beliefs but not desires was also shown in a study that used functional near-infrared spectroscopy (fNIRS; Bowman, Kovelman, Hu, & Wellman, 2015), which directly measures blood flow to cortical regions. These findings shed light of the behavioural findings reviewed above showing that children show sophisticated reasoning about desires before beliefs. In particular, they suggest that the developmental progression from desire- to belief-understanding may be paced in part by development of the right TPJ as it specializes to support an increasingly advanced

understanding of beliefs. Converging support for this possibility comes from fMRI work by Saxe and colleagues (Saxe, Whitfield-Gabrieli, Scholz, & Pelphrey, 2009; Gweon, Dodell-Feder, Bedny, & Saxe, 2012) who showed that 6-year-old children show specialized activation in the dMPFC for reasoning about others' mental states, specialized activation in the rTPJ did not emerge until children were about 9- to 11-years old. The whole set of findings suggests that the medial prefrontal regions that support theory of mind reasoning may reach functional maturity early in development and contribute to reasoning about a range of theory of mind skills. In contrast, the rTPJ, which appears to be especially important for reasoning about beliefs, has a longer developmental timeline that may begin in the preschool years but clearly extends well after.

There are two noteworthy implications of these developmental patterns. The first is that the DMPFC may support a sort of general theory of mind that contributes to a host of theory of mind tasks and is involved whenever making judgments about others' mental states. The development of the functional specialization of the DMPFC may also represent a sort of rate-limiting factor such that the healthy development of these regions may have particularly profound effects on the typical theory of mind reasoning. The second implication is that, echoing our review of the behavioral literature, the development of theory of mind understanding does not end when children become skilled at passing false belief tasks (e.g., Dumontheil, Apperly, & Blakemore, 2010). Given the emergence of exciting new paradigms for studying advances in theory of mind reasoning that emerge after the preschool years, the stage is now set to better understand the behavioral correlates of these neurodevelopmental changes in the theory of mind network.

Dopamine. In addition to looking at functional and developmental changes in neuroanatomical structures, some recent work has investigated the extent to which neurochemical factors might be associated with theory-of-mind development. In this regard, particular attention has been paid to dopamine (DA) (e.g., Lackner, Bowman & Sabbagh, 2010). DA is of particular interest because the region of the DMPFC that is important for theory of mind and implicated in its development lies along the meso-cortical DA pathway. Moreover, DA signalling appears to be sensitive to a number of cognitive processes that have been thought to be important for developing correct inferences about others' mental states, such as adjusting predictions based on feedback (see Sabbagh, 2016 for a recent review).

There are now two pieces of evidence suggesting that individual differences in DA functioning may be associated with false belief performance in preschoolers. The first is that individual differences on an indirect marker of DA functioning, spontaneous eye blink rate, are associated with performance on a battery of false belief tasks (Lackner et al., 2010). The second is that allelic variation in the D4 dopamine receptor gene (DRD4) is associated with theory of mind such that children with genes that promote more efficient DA signaling in prefrontal cortex show better performance (Lackner, Sabbagh, Hallinan, Liu, & Holden, 2012). The connection between theory of mind and DA was specific to the DRD4 gene, which is most strongly predictive of DA binding in the prefrontal cortex; similar associations were not seen for genes that are associated with either DA metabolism (i.e., COMT), or synaptic DA in the striatum (i.e., DAT1). These findings dovetail nicely with the findings from the neuroanatomical studies in showing that healthy medial prefrontal development and functioning is associated with transitions in preschoolers' theory of mind understandings.

A Broader Neural Network and emerging directions. Although the bulk of the work on the neurobiological bases of theory of mind have, like the early behavioral work, focused on children's conceptualizations of beliefs and desires, it is important to note that the network of regions implicated in mental-state reasoning extends beyond these two regions. The superior temporal sul-

cus (STS) and the precuneus (PC) are part of a broader network of neural regions supporting ToM in adults, and these regions likely support aspects of theory of mind in development as well. For example, the STS is recruited when school aged children infer intentions from action (Ohnishi, et al., 2004, Mosconi, Mack, McCarthy, & Pelphrey, 2005) and when young adolescents think about the self (Pfeifer, Masten, Borofsky, Dapretto, Fuligni, & Lieberman, 2009). The precuneus is recruited when children's reasoning about multiple different mental states examined together including beliefs, desires, and knowledge (Gweon et al., 2012; Saxe et al., 2009). As noted above, longitudinal work is necessary to establish a causal role for these aspects of brain development and the relevant behavioral changes in theory of mind reasoning.

Connected with the project of understanding the neural systems that support reasoning about intentions in action, some researchers have focused on a neural rhythm present in the electroencephalogram (EEG), known as the "mu rhythm," as a candidate neural mechanism facilitating developments from early emerging understanding of actions and intentions to more sophisticated representational understandings of complex mental states including beliefs (e.g. Marshall & Meltzoff, 2014). In both adults and infants/children, mu-rhythm reflects EEG oscillations (8-13 Hz in adults, 6-9 Hz in infants/children) recorded over and localized to sensorimotor cortex that suppress when adults, children, and infants either produce or perceive intentional actions (e.g., voluntary hand movement) (see Fox et al., 2015 for meta-analysis; Hobson & Bishop, 2016 for large-scale study with adults). These findings suggest that mu suppression may be a reliable neural correlate of the representation of intentional action. (e.g., Marshall & Meltzoff, 2011). It is these connections to both action-production and action-representation that lead researchers to postulate mu rhythm as a potential neural mechanism facilitating links between actions and the mental states that motivate them (Marshall & Meltzoff, 2014).

Recent evidence suggests that mu-suppression is associated with the perception of meaningful intentional action in infants, and with theory of mind developments in older children. For example, Filippi and colleagues (2016) examined mu rhythm as 7-month-old infants engaged in a goal-imitation paradigm. Infants viewed an actor reach for and grasp one of two objects, and then had the opportunity to reach for and grasp either the same object previously chosen by the actor. Infants who showed strong mu suppression during the familiarization were more likely to imitate the speaker's goal-action than were children who showed weak mu suppression. With preschool-aged children, Bowman and colleagues (2016) found that mu-suppression was a critical factor in mediating the association between preschoolers' action production and their performance on standard theory of mind tasks. In each case, the findings suggest that mu-suppression indexes processes that are critical for facilitating the links between the perception and production of action, and understanding the mental states that motivated them. Developing a detailed accounting of the role of mu-suppression is an important avenue for understanding the online processes that are critical for imputing mental states to others.

Summary. There is now evidence that the functional development of the theory of mind network, including regions of the dMPFC and the rTPJ, are associated with transitions in preschoolers' theory of mind development. There is also evidence that the rTPJ, which becomes specialized to support reasoning about representational mental states like belief, has a longer developmental timeline than the dMPFC, which has a broader purpose in theory of mind reasoning and develops its specialization sooner. The importance of the dMPFC is further underscored by an association between dopaminergic functioning and theory of mind development. Emerging directions include understanding how the neural substrates that are responsive to the perception and production of

intentional action may also be a key contributor the emergence of theory of mind reasoning.

Experiential bases of theory of mind development

Although there are broad cross-cultural synchronies in theory of mind development that are likely shaped by specific neuromaturational factors, it is now also clear that variations in the rate and character of theory of mind development can be affected by children's socio-cultural experiences. The role of experience is bluntly captured in training studies whereby children exposed to concentrated diets of theory-of-mind relevant experience (one-on-one with an experimenter) show improved performance on tasks over a matter of minutes (e.g., Hale & Tager-Flusberg, 2003) or weeks (e.g., Amsterlaw & Wellman, 2006). However, in this section we will focus on research done within a socio-cultural framework that views children as situated within a broad interconnected web of naturally occurring factors that can be more or less proximal to children's everyday experiences (see e.g., Carpendale & Lewis, 2004). Despite their interconnected nature, we will summarize the positive findings relevant to these factors independently. It is noteworthy that a recent meta-analysis testing effects described below confirmed that the effects of most experiential factors are small (typically between $r = .15$ – $.20$) but reliable across a number of studies (Devine & Hughes, 2016).

Parent-child conversation. Perhaps the most well-established finding in the literature on how experience affects theory of mind development is that parent talk about mental states is positively associated with preschool children's performance on false belief tasks (e.g., Ruffman, Slade & Crowe, 2002, see de Rosnay & Hughes, 2006 for a review). In these studies, parent-child dyads are typically observed in the laboratory or in their homes as they engage in an everyday activity, such as picture book reading or telling stories based on cards. These activities are thought to capture parents' "mind-mindedness" — or the extent to which they are focused on the appropriate (i.e., timely and accurate) discussion of mental states (Meins, et al., 2002). These discussions can be about children's mental states, parents' mental states, or the mental states of the story characters they are reading about. Across a number of studies, parents' mental state talk, particularly their use of language relating to epistemic mental states such as knowledge and beliefs, is positively associated with children's false belief understanding (e.g., Adrian, Clemente, & Villanueva, 2007; Dunn, Brown, Slomkowski, Tesla, & Youngblade, 1991; Racine, Carpendale, & Turnbull, 2006; Ruffman, Perner & Parkin, 1999). Of these demonstrations, studies by Ruffman et al. (2002) and Adrian et al. (2007) were particularly notable because it employed longitudinal designs that enabled them to establish a causal role for parent mental state talk in the trajectory of false belief understanding.

Siblings and peer interactions. Further evidence that is generally consistent with the view that conversational experience plays a critical role in theory of mind development comes from findings showing that the number of similar-aged siblings preschoolers have is positively correlated with their false belief understanding (e.g., Jenkins & Astington, 1996; Perner, Ruffman, & Leekham, 1994). In particular, it appears that the number of slightly older aged siblings is a critical factor (e.g., McAlister & Peterson, 2013). In each of these cases, it is thought that siblings provide preschoolers with regular opportunities to encounter mental states that are different from their own in ways that need to be understood in order for successful social interaction. Further to this point, Wang and Su (2009) found that false belief understanding was accelerated in urban Chinese preschoolers (who rarely have siblings) who were in daycare with children of varying ages rather than children's same age. These findings all support the general claim that a rich variety of conversational experience plays an important role in setting the time table of theory of mind development.

Theory of mind in deaf children. Perhaps the most dramatic demonstration of the role of verbal experience comes from work on individuals who are born deaf into hearing families. Children who are born deaf, or who lose their hearing in the first year of life and are raised in non-signing families do not experience the rich linguistic input that is immediately available to either deaf children raised in signing families or hearing children raised in speaking families (Peterson & Siegal, 1995). Several studies have demonstrated delays in these deaf children's theory of mind performance. Compared to hearing children and deaf children born into signing families, deaf children born to non-signing families are substantially delayed on standard explicit false-belief tasks (Woolfe, Want, & Siegal, 2002), and on explicit understanding of other mental states including desires and knowledge (Peterson, Wellman & Liu, 2005). More recent work has suggested that these findings might be due to the fact that hearing parents of deaf children use fewer mental state terms than do hearing parents of hearing children (Moeller & Schick, 2006; Morgan, et al., 2014). These findings show that just as typical variation in theory of mind relevant conversational experience has small but reliable effects on preschoolers' false belief development, the putatively extreme variation associated with deaf children born to hearing parents can result in striking delays.

SES. In addition to the proximal factors that might directly affect the quantity and quality of children's theory-of-mind relevant experiences, there is some evidence that socio-economic status (SES) is positively associated with false belief development as well. SES is often considered as an aggregate of a number of different variables, including parental education, income and occupation, marital status and more. Although rarely an explicit focus of a study (though, see Pears & Moses, 2003), SES measures are often collected by researchers interested in the effects of the experiential variables discussed above (e.g., Jenkins & Astington, 1996). In the meta-analysis mentioned above, Devine and Hughes (2016) reported that in fact there is a highly reliable association between aggregate SES measures and false belief understanding. Indeed, it is one of the strongest effects of experience reported. Thus, it appears that distal factors can have strong effects on the timetable and trajectory of theory of mind development.

Summary. There is considerable evidence demonstrating the influence of children's social experience on their developing understanding of mental states. Through children's experiences with others—parents, siblings, same-age peers—an understanding of their own and others' minds is grown and sharpened. However, it is important to note that the meta-analytic data also demonstrates that the effects of these experiences are small. Except for the case of deaf children born to hearing parents, the correlations between social variables and children's false-belief understanding were statistically but each accounted for just 2 and 4% of the variance in children's false-belief understanding performance. There are two important future directions for this literature. The first is that there may be much more work to do to better understand how experience affects theory of mind development. Although there have not been many behavioral genetics studies that have attempted to parse the extent to which theory of mind skills are heritable, one influential one suggests that a substantial proportion (44%) of the variance in 5-year-olds' theory of mind performance is due to non-shared theory of mind specific experiences (Hughes et al, 2005). Although newer estimates may vary, the discrepancy between the effects of experience estimated from behavioral genetics work and the experimental work that directly measures the effects of experience requires explanation. Targeted work aimed at gaining a diverse set of reliable measures of relevant experience may be critical to understanding its full effects and its theoretical importance. The second important direction is to explicitly recognize the interplay between these experiential factors and the cognitive architecture that is necessary to use that experience to promote meaningful conceptual change.

Theory of mind in the real world: a few examples

From the outset, we noted that part of the appeal of theory of mind as a research topic is its importance in facilitating the smooth flow of everyday social interaction. The way in which we naturally make sense of others' behaviors is through understanding their intentions, which themselves are understood in terms of underlying beliefs and desires (e.g., Wellman, 1990). Because of this theoretical connection between theory of mind and social understanding, we would expect that facility with theory of mind reasoning might be predictive of social competence. As we consider this question, however, it is important to recognize that the links between theory of mind development and common metrics of social competence (e.g., peer acceptance, social network size, etc.) are likely to be weak and complex for several reasons. First, theory of mind skills may be particularly important for social problem solving, but not for more affective aspects of social competence (e.g., empathy, homophily) that are also important for social success. Second, because of the changing nature of children's peer relationships, the importance of theory of mind may vary with age. Some work has attempted to connect theory of mind development with social competence, broadly construed. However, a tighter focus has been on the detailing the connections between theory of mind development and those components of social understanding that especially require a mature understanding of mental states.

Theory of mind and Social Competence

There is some evidence that individual differences in children's theory of mind are associated with social competence, broadly construed. For instance, one study found that 3- to 6-year-old children's performance on false belief tasks was positively correlated with teacher ratings of social skills, but not with peer acceptance (Watson, Nixon, Wilson, & Cepage, 1999). When similar questions were investigated in another study that took a more fine-grained approach, false-belief understanding was associated with peer acceptance for older but not younger children (Slaughter, Dennis & Pritchard, 2002). More recent findings suggest that the relationship may be a longitudinal one whereby early facility with theory of mind predicts later social success. For example, Devine and colleagues (Devine, White, Ensor & Hughes, 2016) showed that theory of mind assessments given at age 6 was positively associated with teacher-rated social competence at age 10 (see also Caputi, Lecce, Pagnin, & Banerjee, 2012). These findings suggest that at the broader level, theory of mind skills play some role in facilitating social competence over a long time scale, but that meeting theory of mind milestones does not suddenly lead to increased social competence.

Deception

Deception is the intentional use of communicative acts to cause another to believe something that is not true (see e.g., Lee, 2013 for a recent review). Deception and lying can happen for various purposes. For instance, some lies are self-serving — after causing damage to family property, a child might lie about their involvement to avoid a potential punishment. Other lies might be undertaken to help another person feel good. For instance, upon receiving an undesirable item as a gift, one might lie about those feelings in order to avoid offending the giver. Intuitively, successful deception appears to rely on false belief understanding; after all, the point of deception is to cause someone else to hold a false belief about some true state of affairs (e.g., Newton, Reddy & Bull, 2000). However, there are alternative explanations for children's early deception. For instance, it is possible that

children who lie are simply hoping that disavowing responsibility for wrong doing will help them avoid punishment, without understanding the causal role of false beliefs (e.g., Sodian, 1991).

One way in which researchers have moved away from this ambiguity in understanding the cognitive-motivational underpinnings of children's simple willingness to tell a lie is by investigating the more interesting question of whether developmental advances in false belief understanding change the character of children's deception. That is, perhaps as children's theory of mind becomes more sophisticated, so too does their capacity for successful deception. Indeed, this seems to be the case. In a pioneering study, Talwar and Lee (2008) found that children's abilities to falsely deny that they had committed a minor transgression in a laboratory session (i.e., peeking at the contents of a container when they had been told not to) were positively related to their false belief understandings. Furthermore, children's abilities to maintain a lie are associated with second-order theory of mind abilities; that is, children with stronger second-order false belief skills were better able to conceal information that would be "telling" about their lie, and conceal facial and emotional expressions that are thought to be associated with lying (see Talwar, Gordon & Lee, 2007). These findings have been demonstrated with lies to cover up transgressions and with lies that are meant to make others feel better (Broomfield, Robinson, & Robinson, 2002; Williams, Moore, Crossman & Talwar, 2016). Thus, the data are clear that as children's theory of mind becomes more sophisticated, so too does their capacity for successful deception.

Moral Judgment

Theory of mind provides a way of explaining and predicting other's behaviors with respect to their most proximal causes (i.e., intentions, desires, and beliefs). It is important to remember, however, that theory of mind considerations are also important for the meaningful evaluation of others' actions. One place where this is particularly apparent is in the case of making moral attributions. As philosophers have pointed out, others' actions are morally evaluated not simply in terms of their outcomes but also in terms of whether those outcomes were intended (see e.g., Kaplan, 2001; Mele & Sverdlik, 1996). For instance, people intuitively assign blame and punishment to people more severely to people who intend to cause bad outcomes than they do to people who cause bad outcomes unintentionally (Leslie, Knobe & Cohen, 2006). Indeed, the distinction between negative outcomes that are intended versus not intended is commonly included in most legal systems — when the negative outcome is the death of another individual, intentionality determines whether the crime is manslaughter or murder. Thus, our ability to make accurate inferences about others' intentions is a key feature of moral evaluation (Gray, Young, & Waytz, 2012; Knobe, 2005).

These intuitions about moral evaluation hinge on the ability to use an explicit representational theory of mind — that is, to think about how mental states are dissociable from observable actions. What we would predict, then, is that as children's theory of mind becomes more sophisticated, so too should their intuitions about moral responsibility. There is some evidence that around the time false belief understandings are emerging, young children are more likely to judge negative outcomes that are brought about freely and intentionally as more immoral than ones that are brought about by force or accident (Chandler, Sokol & Hallett, 2001; Josephs, Kushnir, Grafenhain, & Rakoczy, 2016; Yuill & Perner, 1988). During the preschool years, children also come to believe that someone who attempted harmful behavior was morally wrong, even if they were unsuccessful (Cushman, Sheketoff, Wharton, & Carey, 2013). More direct evidence on the question of the association between theory of mind development and morality comes from work by Killen and colleagues who presented children with what they called "morally-relevant theory of mind (MoToM)" tasks. In these tasks, children

heard stories in which characters unknowingly and accidentally brought about a negative outcome and then asked to answer questions about the characters' intentions and beliefs. Children who correctly said that the story character was unaware that she had done something wrong were also less likely to view the transgression as morally wrong (Killen, Mulvey, Richardson, Jampol & Woodward, 2011). Finally, there is evidence that theory of mind understandings measured at 3.5-years-old are positively associated with children's reasoning about moral acts 2 years later (Lane, Wellman, Olson, LaBounty, & Kerr, 2010).

Taken together, these findings clarify that children's developing understandings of the representational nature of mental states (as indexed by false belief understanding) have important implications for their understanding of morality. Prior to the age of 4-years-old, children appear to believe that negative outcomes that are brought about either accidentally or intentionally are morally wrong. However, as they come to recognize that there can be a distinction between intentions and outcomes, they come to privilege intentions over outcomes in their assignment of moral value (Cushman, et al., 2013).

Summary

There is evidence that theory of mind development is associated with social competence broadly construed, and with specific social understandings that rely on the acquisition of particular theory of mind milestones. Although we reviewed two specific understandings, it should be noted that there is literature suggesting that theory of mind development might affect several others that have been explored, including playing strategic games (ref), cooperation, establishing epistemic trust (Harris & Koenig, xxxx), and more. These bodies of work show that though theory of mind is a relatively narrowly construed aspect of conceptual development, its implications for children's abilities to navigate the social world are profound. This point becomes even clearer when considering the theory of mind difficulties experienced by those with particular developmental disorders and how those difficulties might affect their social cognitive functioning.

Developmental disorders, Autism, and theory of mind

A host of developmental disorders are characterized by serious impairments in social functioning, including attention-deficit hyperactivity disorder (ADHD), specific-language impairment (SLI), Down's syndrome and autism. Indeed, social impairment is often the most troubling symptom of these disorders for caregiving families. Given its hypothesized importance in social functioning, researchers have investigated whether difficulties in theory of mind might be a phenotypic characteristic of these developmental disorders. When investigating this question, however, there is an important distinction to be made with respect to characterizing the source of theory of mind difficulties. One possibility is that theory of mind understandings are affected in a domain-specific way, such that there are difficulties that exist for theory of mind reasoning independent of factors that might also affect conceptual understandings and problem solving in other domains, such as physical understandings or number (see e.g., Baron-Cohen, 1995). An alternative possibility is that theory of mind difficulties exist because of primary impairments in domain-general factors that affect children's abilities to either develop or use theory of mind in everyday situations. As was noted above, there is evidence that executive functioning is causally related to the theory of mind developments that occur over the preschool years. Accordingly, we might expect that any developmental disorder

in which executive functioning or language development is impaired would also be associated with theory of mind difficulties, and their sequelae.

Primary deficits in executive function and theory of mind delays

Although no one disorder has been studied in much detail, there is evidence that those that feature primary deficits in executive functioning skills are also associated with difficulties in false belief reasoning, including Down's syndrome (e.g., Cebula, Moore, & Wishart, 2009; Zelazo, Burack, Benedetto, & Frye, 1996), William's Syndrome (e.g., Mervis & John, 2010), Fragile-X syndrome (Grant, Apperly, & Oliver, 2007) and Fetal Alcohol Spectrum Disorder (Lindinger, et al., 2016; Rasmussen, et al., 2013). In the majority of these cases, the difference in false belief performance between affected children and typically-developing children is statistically accounted for by group differences in executive functioning. Moreover, in some cases the association between executive functioning skills and false belief performance is stronger in the affected children relative to the unaffected (e.g., FASD, see Rasmussen, Wyper, & Talwar, 2009).

A more mixed pattern of results is apparent for children with ADHD which is another developmental disorder that is characterized by primary difficulties in executive function. Although some find that affected children have difficulties with theory of mind tasks relative to age-matched controls, and that these differences can be accounted for by group differences in executive functioning (e.g., Mary et al., 2016), others have not (e.g., Charman, Carroll, & Sturge, 2001; Perner, Kain, & Barchfeld, 2002). The reasons for the mixed findings may have to do with the measures that are used; ADHD is not typically diagnosed until children enter school and the false belief task (both first-order and second-order) may not be appropriate for use with this age group. A recent study showed that although children with ADHD may not have difficulty with laboratory theory of mind tasks, they do have difficulties on tasks that require them to apply theory of mind understandings to real-world scenarios (Hutchins et al., 2016). Taken together with the above findings, there is evidence that developmental disorders that are characterized by primary difficulties in executive functioning can also have secondary difficulties in theory of mind reasoning that may in turn affect aspects of their social functioning.

Autism

Perhaps the developmental disorder that has received the most scrutiny in the present context is Autism and Autism Spectrum Disorders (Baron-Cohen, 2000). Autism is a developmental disorder that has many features, but perhaps the most striking difficulty in autism concerns social impairments. This symptom profile led many researchers to suggest that theory of mind impairments may be a primary feature of ASD (Baron-Cohen, 1995) rather than a secondary feature that emerges because of other primary deficits such as executive function or language.

Even a cursory summary of the wide literature that has investigated theory of mind difficulties in autism is beyond the scope of this chapter. Briefly, the claim that individuals with ASD have a primary impairment in theory of mind reasoning comes from research that has taken a "fine cuts" approach (see, Frith & Happé, 1994). This approach is an experimental one in which researchers measure performance on theory of mind tasks – such as the false belief task – along with performance on tasks that are formally and structurally similar to the false belief task but involve non-mental content. For instance, Leslie and Thaiss (1992) measured ASD individuals' performance on a false belief task and a "false photograph" task which was thought to be identical to the false

belief task but involved non-mental content. Findings from these studies and others like them (e.g., Baron-Cohen, et al., 1985) consistently find that ASD individuals perform well on the tasks that involve reasoning about non-mental representations, but poorly on tasks that involve reasoning about mental representations (see e.g., Baron-Cohen, 2000 for a review). These results stand in contrast to typically developing individuals and those with non-ASD developmental disorders who tend to perform similarly on both kinds of tasks, in accordance with their mental age.

It should be noted that the “theory of mind hypothesis” of autism that proposes primary theory of mind deficits is controversial. There is a large literature showing that autism is associated with difficulties in executive functioning (e.g., Corbett, Constantine, Hendren, Rocke, & Ozonoff, 2009) and so it remains possible that the theory of mind deficits in autism are secondary to those. Indeed, the association between executive functioning and false belief performance is exceptionally high in ASD (Zelazo, Jacques, Burack & Frye, 2002; Colvert, Cusack, & Swettenham, 2002), thereby suggesting that executive functioning may be the primary limiting factor on theory of mind reasoning in ASDs. Others have suggested that theory of mind deficits in ASD may be secondary to a broader difficulty in forming “central coherence” or engaging in more holistic processing (Happé & Frith, 2006). Nonetheless, although it is still unclear whether theory of mind deficits are primary or secondary in autism, it is clear that individuals with ASDs have substantial difficulty in reasoning about others’ mental states.

Summary

There are developmental disorders in which theory of mind difficulties can be primary (such as Autism) or secondary to deficits in cognitive skills that are important for acquiring or using theory of mind concepts (e.g., FASD). Most important is that no matter what the source, difficulties in theory of mind reasoning may lead to broader difficulties with social functioning which is often one of the most challenging aspects of caring for children with developmental delays. Taking a theory of mind perspective may be valuable insofar as it provides a specific target for intervention and training that could have broader implications for establishing more rewarding social interactions in these situations.

Theoretical frameworks of theory of mind development

The richness of the empirical work in theory of mind development has been supported by a robust theoretical debate concerning the origins of theory of mind and the mechanisms by which theory of mind judgments become more reliable over time. Although a fair summary of the nuanced theoretical positions is well-beyond the scope of this paper, we will attempt a brief summary of three general theoretical approaches here.

Theory theory

The theoretical position that is perhaps most tightly connected with the theory of mind literature is the “theory” theory (Gopnik & Wellman, 1992, 2012; Perner, 1991). The premise of theory theory is that children begin life with a basic ability to impute general psychological causes to human behavior, but the precise content of the psychological causes is undifferentiated and/or immature. Over time and with experience, children are thought to notice instances in which their current understanding leads to mistaken or otherwise inept predictions of how people behave. These prediction

errors serve as a catalyst for children to refine or revise their understandings about the nature of psychological causes, much in the same way that a scientist refines or revises their theories about the causes of any natural phenomenon. In the end, these psychological causes are comprised of adult-like mental state concepts. Recently, computational processes (e.g., hierarchical Bayesian learning) have been offered as a way of characterizing the ways in which the revision process might take place. Research that we have discussed above that has been spurred by the theory theory perspective includes 1) work that characterizes young children's (including infants') early understandings of mental states, and maps out the qualitative differences between early and later understandings, 2) work that focuses on the ways in which children's diet of experience affects the timetable and trajectory of theory of mind development, and 3) work that characterizes the cognitive and neurobiological mechanisms that might be important for revising and refining mental state understandings based on experience in the world (e.g., executive functioning, medial prefrontal cortex, dopamine).

The general approach that theory theory takes to characterizing mechanisms of change is essentially continuous with long-standing theoretical perspectives in cognitive development, especially Piaget's processes of equilibration (e.g., assimilation and accommodation) (Gopnik, 1996). Accordingly, the theory theory is susceptible to many of the critiques that Piaget's model was, including a lack of specificity of the processes by which change occurs and the characterization of the child as a highly rational agent who continually engages in sober reflection on mistaken ideas and their alternatives (see e.g., Faucher et al., 2002). Nonetheless, the emphasis that the theory theory framework places on infants having some psychological understandings from early on that become elaborated over time and with experience has been a fruitful one for pursuing meaningful empirical work in the field.

Social construction views

Placing even more emphasis on the role of experience in theory of mind development are social construction views. These theorists follow the lead of socio-cultural theorists in arguing that ascribing mental states to others is a cultural practice, and that the skillful application of those practices comes from cultural learning (e.g., Heyes & Frith, 2014). These intuitions have been formalized in theoretical accounts of theory of mind development. For example, Carpendale & Lewis (2004) make the case that theory of mind development takes place through social interaction. They argue that an understanding of the mind is constructed through triadic interactions between the child, another person, and the world. Nelson (2009) similarly argues that changes in children's understanding of mental states occur through pragmatic conversations in social interactions. Research carried out within this perspective concerns the effects of culture and experience on the timetable and trajectory of theory of mind development.

Though this perspective is an important one, it faces several challenges from the broader literature. First, it does not attempt to account for many of the known facts about the developmental trajectory of theory of mind understandings (e.g., why an understanding of desires comes before beliefs). Second, as noted above, is it unclear as to how much known experiential factors account for variance in preschoolers' theory of mind development. Nonetheless, this perspective is a valuable counterweight to the more child-focused processes that typically dominate theory and research in this area, and remind researchers to bear in mind the socio-cultural context of social cognitive development.

Innateness & Modularity

A third prominent framework for studying theory of mind development is the “innateness” view. As with language, proponents of the innate view suppose that the set of hypotheses for potential psychological causes cannot be constrained or specified on the basis of experience alone (German & Leslie, 2004). And thus, children must be born with mechanisms that take the perception of relevant social behaviors as input and generate a plausible set of psychological causes for those behaviors (Scholl & Leslie, 1999). Importantly, the character of those psychological causes is essentially adult-like from the beginning. Development occurs, then, as children become better at selecting the most appropriate psychological cause given the extant behavior. Research that has been spurred on by this perspective includes 1) work showing that infants show false belief understanding, 2) work showing that factors that affect the selection of appropriate psychological causes (e.g., executive functioning) affect both preschoolers’ and adults’ performance on theory of mind tasks (e.g., false belief), and 3) work showing that individuals with autism experience a specific deficit in reasoning about mental states, even when their reasoning in other domains is unaffected.

Critiques of the innateness view pertain largely to the fact that it does not easily account for particular findings in the literature such as why young children proceed through a relatively stereotyped set of coherent understandings in a relatively circumscribed period later in development, and why experience plays such a reliable role in shaping the timetable by which those understandings change (Wellman, 2014). Yet, this approach has been extremely valuable for characterizing the remarkable social-cognitive competencies that infants show (irrespective of their ultimately correct interpretation) and the surprisingly specific ways in which theory of mind reasoning may be affected in cases of abnormal development.

Concluding Remarks

Theory of mind is a research area that has seen sustained interest over the past 3 decades and continues to influence work on children’s social cognitive development. Arguably, we know more about theory of mind development during the preschool years than we know about any other comparable conceptual change. Here, we have reviewed much of what is known about the timetable and trajectory of theory of mind development, the factors that affect those developments, and their broader consequences for social cognitive development. Although we have attempted to cover a lot of ground, there was still important work that we had to omit because of space considerations. Perhaps most notable among these are the rich and substantial literatures on connections between theory of mind and pretend play (see e.g., Harris, xxxx) and between theory of mind and language (see e.g., Astington & Baird, xxxx). These literatures both have long empirical records and important theoretical implications and we regret that we could not include substantive discussion of them here.

Although our field has acquired much important knowledge about theory of mind development, there is much still to know about the developments that precede and succeed the milestones that occur in the preschool years, and the mechanisms that support those changes. This research, particularly the research on mechanisms of change, is still in its early stages and holds substantial promise for understanding not just the particular developments that are important for theory of mind, but conceptual development more broadly.

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