

Social Cognition and Education: Theory of Mind

Cognición social y educación: teoría de la mente

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Abstract

Theory of mind —children’s understanding of themselves and others in terms of internal mental states, such as thoughts, wants, and emotions— influences children’s transition to school and their success within school. This article reviews evidence showing that theory of mind influences school-age children’s relationships with their peers and teachers, and thus their adjustment to school. It also influences children’s academic motivation within school and for school tasks. Theory of mind further directly influences children’s successful performance on, and strategies for undertaking, academic tasks, such as reading and mathematics. Moreover, it fosters children’s abilities to provide explanations, which in turn help them learn new material more effectively from teacher instruction and from school textbook material.

Keywords: theory of mind, education, learning

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Resumen

La teoría de la mente (la comprensión que tienen los niños sobre sí mismos y de otros en términos de estados mentales internos, tales como pensamientos, deseos y emociones) influye en la transición de los niños en el ingreso a la escuela y su éxito dentro de esta. Este artículo analiza la evidencia que muestra que la teoría de la mente influye en las relaciones de los niños en edad escolar con sus pares y profesores y, de este modo, su adaptación en la escuela. También impacta en la motivación académica de los niños en la escuela y en las actividades escolares. La teoría de la mente además influye en el desempeño exitoso de los niños y en las estrategias que utilizan en tareas académicas, tales como lectura y matemáticas. Más aún, la teoría de la mente fomenta las habilidades de los niños para proporcionar explicaciones las que, a su vez, les ayudan a aprender de manera más efectiva nuevo material, tanto de la instrucción del profesor como de los textos escolares.

Palabras clave: teoría de la mente, educación, aprendizaje

In my research and writing I focus largely on social cognition and theory of mind, but not often on education. For example, in Wellman (2014), there are only scattered, indirect, and partial mentions of theory of mind in the context of education. Yet, theory of mind has numerous indirect and hidden influences on children within educational settings and thus on their education. Moreover, there is emerging research about how theory of mind more directly influences educational outcomes. So, this article provides a welcome opportunity to address the relationships between theory of mind and education in an organized fashion.

The article begins with some brief conceptual and empirical background on theory of mind. Much of the empirical findings in this first section focus on theory of mind developments in the preschool years, as does much of the extant research in the field. However, this sort of social cognition continues to progress beyond the preschool years with several advances apparent as children make the transition to their school years. Therefore, next, the discussion turns to that transition, as well as research with school-age children. In doing so, it provides a skeletal framework for thinking about theory of mind in relation to school settings and school accomplishments, and provides examples of emerging research on various topics outlined by that framework.

All of this raises the question of whether theory of mind reasoning be enhanced; can theory of mind itself be taught? One way in which it can is by using and building on children's explanations. I focus on this method for enhancing theory of mind because use of children's own explanations to shape their learning has broader implications for education.

Theory of mind background

A recent search of the phrase *theory of mind* on Google yielded 36 million hits. So, the claim that theory of mind (ToM) is an important part of our ordinary understanding of people is now common. Here is how the claim goes. Humans are an incredibly social species. We live socially. We not only live socially, we think socially, achieving a vast array of social cognitions about identities, roles, social actions, and interactions. This vast array of human social cognition raises an interesting question: are there underlying, core conceptions that frame and organize this immense knowledge? The claim behind ToM is that there are; the foundation for human social cognition is a construal of ourselves and others in terms of our inner mental, psychological lives.

Consider this passage from Isabel Allende's *House of Spirits*:

Marcos announced that [...] he planned to take off in his bird and cross the mountain range [...] The contraption lay [...] heavy and sluggish and looking like a wounded duck [...] No one *believed* that his contraption could fly [...] Journalists and the *curious* flocked to see it. Forty years later his great-nephew Nicolas [...] unearthed the *desire* to fly that had always existed in the men of his lineage [...] Against all logic, the bird lifted off without mishap and with a certain elegance [...] The *astounded* crowd filled all the nearby streets (Allende, 1985, pp. 20-21).

This is great literature. However, understanding persons as curious, desiring, believing, feeling beings is not only the stuff of great literature; it is also the stuff of everyday life.

Consider the Chilean miners trapped far underground in 2010 by a mine cave-in in the Atacama Desert. When they were first discovered alive, it was by use of a slim electronic probe. The miners were still trapped, but at that point they could send messages up to their families. Here is what one man sent in his first message to his wife: «We *thought* we were going to starve to death down here. You can't *imagine* how much my soul hurt *wanting* to tell you, but unable to let you *know* we were alive» (Tresniowski & McNeil, 2010, p. 97).

A mentalistic construal of persons—in terms of thoughts, wants, imaginings, and knowing—radiates from this message. Indeed, the whole Chilean mine drama was about hopes, fears, desires, thoughts, and persons, as is much of our everyday social cognition.

Beliefs-desires-actions

Briefly, how do these mental construals work? Philosophers and psychologists agree that, in shorthand, ToM reasoning is organized around three large categories of mind and behavior. Because agents have certain beliefs and desires, they engage in certain intentional actions. Or, in our everyday understanding, we construe people as engaging in *acts* they *think* will get them what they *want*. In the *House of Spirits*, Marcos wanted to fly, thought he could, so he tried it.

ToM reasoning is certainly more complicated than this alone, and in a bit more detail must include at least the related constructs and connections shown in Figure 1. People's perceptions and basic emotions (among other things) ground their beliefs and desires. Beliefs and desires not only shape actions, but also shape actors' reactions to what their acts produce. In the *House of the Spirits*: because they *saw* the contraption, no one but Marcos *believed* it would fly. Because it was part of his lineage, Marcos *wanted* to fly. Later when he takes off, Marcos is *pleased*.

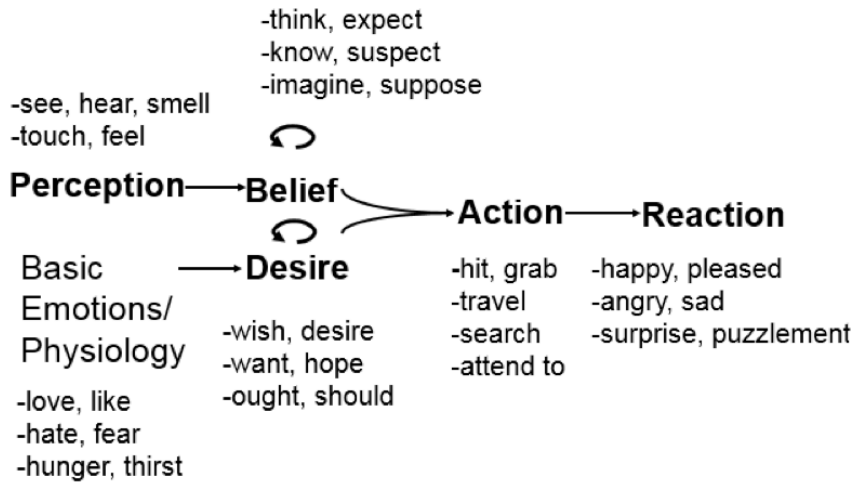


Figure 1. A simplified scheme for depicting belief-desire reasoning. Centrally, we see people as engaging in *acts* that they *believe* will get them what they *desire*. But also, basic emotions and physiological states fuel one's desires; perceptual and evidential experiences ground one's beliefs and knowledge; actions not only occur, they result in outcomes to which there are reactions (adapted from Wellman, 2014).

False belief. Crucially, because they did not believe the unwieldy bird-like device could fly, but it did, the crowd of spectators was *astonished*, surprised. The centrality of this slippage between mind and world, and the centrality of beliefs in particular, is why there has been so much research on children's understanding of false belief. There is even research on understanding of false belief in infancy that will not be considered here (see instead Chapter 8 in Wellman, 2014) so that the discussion can concentrate on children of preschool and school ages.

The top portion of Figure 2 presents one example of the many related preschool false-belief tasks—one that deals with unexpected events. The child sees two boxes, a Band-Aid box and a plain box. The child explores the boxes and finds the Band-Aids in the plain box, and the Band-Aid box is empty. Then Max comes along and wants a Band-Aid. Where will Max look for the Band-Aid? Correct answers—saying that Max will look in the Band-Aid box—show an understanding that people live their lives not so much in the world itself, but in the world of mental states. In reality, the Band-Aid he wants is in the plain box, but Max will look in the Band-Aid box. Children that are 4 or 5 years of age typically solve this problem, as do adults.

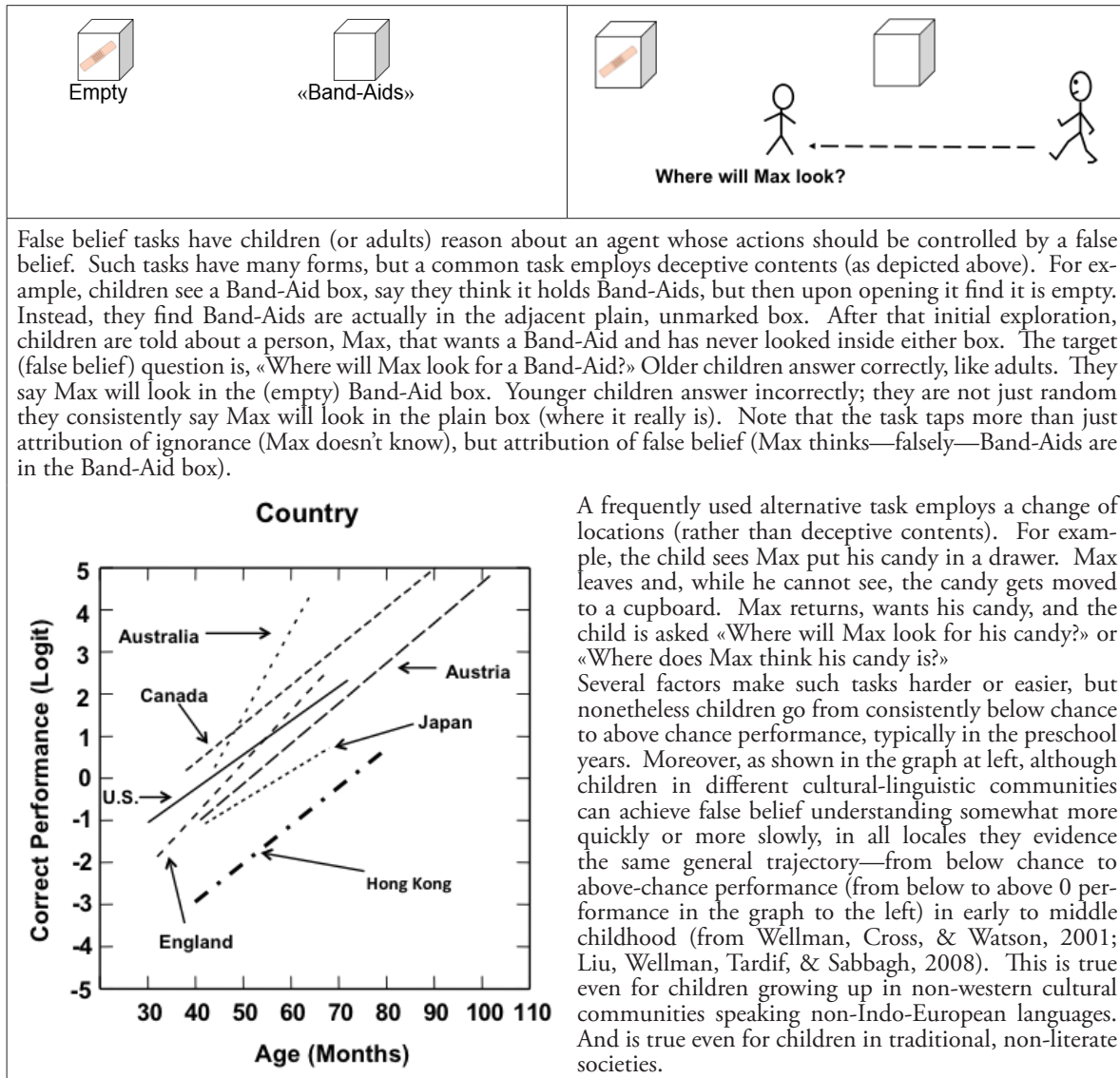


Figure 2. An illustrative false-belief task used with preschool children and a figure showing the developmental trajectory of children’s false-belief responses in various countries.

Theory of mind encompasses many understandings beyond false belief, and I will consider them shortly, but false belief has proven to be a good initial focus, because: (a) false belief tasks can be made very natural for use with children in a variety of everyday situations, and (b) as a result, there is a wealth of false belief data from children in many different cultural communities.

Several years ago, my colleagues and I exploited all of these false belief studies to conduct several large meta-analyses of false belief understanding (Liu, Wellman, Tardif, & Sabbagh, 2008; Wellman, Cross, & Watson, 2001). In total the meta-analyses included more than 250 studies encompassing more than 700 false-belief conditions and task variations, summing data from more than 7,000 children. The tasks were verbal and nonverbal, asking children to judge behavior or thoughts —where will Max look? What does he think?—, using real life humans, videotaped humans, toy figurines, story characters, and more.

The key initial findings revealed that children showed clear early achievement, as well as developmental change. By 5 and 6 years of age, children were largely correct; on a vast array of false belief situations, they were able to judge and explain correctly. However, there was also clear change. Looking backwards to 2 and 3 years of age, children exhibited consistent below-chance performance; classic false-belief errors (see also the meta-analysis by Milligan, Astington, & Dack, 2007).

These accumulated cross-sectional studies show, using false belief as a representative example, one way in which young children develop an explicit understanding of persons' mental states. Children come to understand that a person's actions are importantly controlled by what he or she *thinks*, not just reality itself. Moreover, such tasks have been used worldwide, with many children in many cultural communities, speaking many different languages. As the graph in the bottom portion of Figure 2 further shows, there is similar developmental achievement in all countries, a trajectory from below-chance incorrect judgments to above-chance correct judgments in the years from age 2 to age 6 or 7. False belief understanding is arguably a universal developmental accomplishment.

It is clear in the graph in Figure 2 that within the overall consistent preschool developmental trajectory there is significant variation in timetables across countries. Variation is evident not only across countries, but also (not shown in Figure 2) across individuals. Although almost all normally-developing children eventually master false belief, some children in some places come to this understanding earlier and some later. This variation has helped researchers confirm the impact of achieving preschool theory-of-mind understandings. To reiterate, children's performance on false-belief tasks is just one marker of ToM understanding, but differences in false belief understanding alone predict how preschool children talk to others in everyday conversation, including their attempts to persuade people (e.g., Bartsch & London, 2000), their engagement in pretense (Astington & Jenkins, 1995) and other games (Peskin & Andino, 2003), their social interactional skills (Lalonde & Chandler, 1995; Razza & Blair, 2009), and consequently their interactions with and popularity with peers (Diesendruck & Ben-Eliyahu, 2006; Slaughter, Dennis, & Pritchard, 2002; Watson, Nixon, Wilson, & Capage, 1999). Looking ahead, while these findings importantly confirm theory of mind's real-life relevance, we need to get beyond false belief alone in order to address how ToM relates to children's education. To begin to do this, I first consider a variety and a progression of ToM understandings.

Desires to beliefs. One progression well-established now within the preschool years is that children explicitly understand some key things about desires and intentional actions *before* explicitly understanding about beliefs. How might that be so? First, let me talk conceptually, then empirically. Conceptually, Figure 3 shows a depiction that begins to capture this developmental progression. At the top of that figure, imagine a child who has a simple understanding of desires and certain emotions. Such a child could understand people as subjectively connected to real objects or states of affairs: «I want that.» «He hates that.» But, an understanding of belief, anything like our ordinary adult one, requires understanding people as having something like representations of the world as depicted at the bottom of the figure. «He thinks that's an apple.»

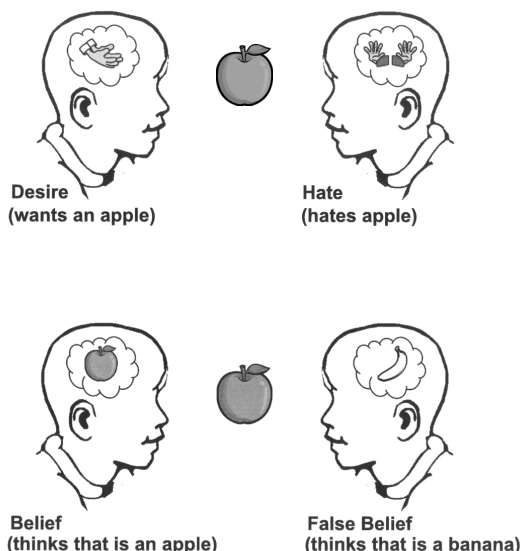


Figure 3. Graphical depiction of a young child's understanding of simple desires (top) and beliefs (bottom). (Adapted from Wellman, 2014).

For simple desires, there are internal states —feelings, urges— directed toward external happenings. This would be true for simple emotions too: «He likes that, I hate it.» But, for a young child with this sort of conception there is only one realm of contents to consider, the contents of the world. «That.» But, for belief and other such representational states, there are two realms of content to deal with —contents of the world and contents of the mind. It is nicely clear that these two differ, for example, in the case of false beliefs. «Really, it's an apple, but he thinks it's a banana.» This analysis helps capture why preschool advances are often talked of in terms of achieving a representational ToM.

This analysis also helps capture why it would constitute a major conceptual change to move from a conception like the top one to the bottom one. Imagine trying to understand Isabel Allende, or any works of magical realism, with only an understanding of the characters' desires. With no conception of their beliefs —true, false, and magical— the characters in an Allende story, and their actions, make little sense. Only with the bottom conception are understandings such as beliefs, false belief, lies, deception, and so on possible.

Of course, the depiction in Figure 3 is misleading, in several ways. Crucially, it suggests there might be just two steps for children as they come to understand persons' mental states, first in terms of desires and simple emotions and then, second, in terms of beliefs, knowledge, deception, and mental contents. However, children actually evidence an accumulating sequence of progressive ToM understandings.

Extended progressions of ToM understanding. Consider Table 1, which outlines a variety of understandings a child might achieve: (a) People can have different desires, even different desires for the same things (Diverse Desires, or DD); (b) people can have different beliefs, even different beliefs about the exact same situation (Diverse Beliefs, DB); (c) something can be true, but someone might not know that (Knowledge-Access, KA); (d) something can be true, but someone might falsely believe something different (False Belief, FB); and (e) someone can feel one way but display a different emotion (Hidden Emotion, HE). These notions capture aspects of mental subjectivity, albeit different aspects (including mind-mind, mind-world, and mind-action distinctions). Listing them in this manner suggests that one could devise a set of tasks with similar formats and procedures, essentially like the false-belief tasks, for example, and see how children do. Wellman and Liu (2004) did just this in constructing a ToM Scale.

Table 1
The ToM Scale items

Task	Brief Description
1. Diverse Desires	Child judges that two persons (the child vs. someone else) have different desires about the same object: Given two possible snacks (ice cream, an egg), child states his preference but then must predict snack choice of other person (who has the opposite preference).
2. Diverse Beliefs	Child judges that two persons (the child vs. someone else) have different beliefs about the same object, when the child does not know which belief is true or false: Child states her belief that object is under bed, hears other person's belief that it is in the cupboard; child never sees where item is, but must predict whether other person will search under bed or in cupboard.
3. Knowledge-Ignorance	Child judges another person's ignorance about the contents of a container when child knows what is in the container: Child sees toy dog in a nondescript drawer, drawer is closed, child judges (yes-no) if other person (who has never seen inside) knows what is in the drawer.
4. Contents False Belief*	Child judges another person's false belief about what is in a distinctive container when child knows what is there: Child sees familiar potato chip tube, discovers it has pencils inside, then must judge belief of someone else who has never seen inside.
5. Hidden Emotion	Child judges that a person can feel one thing but display a different emotion: Character wants uncle to bring him a gun, but uncle brings a book; child judges how character will feel (sad) and what he will show on his face (happy).

*Other false-belief tasks can be used. For several reasons (see Wellman & Liu, 2004) Contents False Belief is the task included in the standard five-step scale.

Using such a battery of tasks, studies encompassing more than 500 preschoolers in the U.S., Canada, Australia, and Germany evidence a clear and consistent order of difficulty (e.g., Kristen, Thoermer, Hofer, Aschersleben, & Sodian, 2006; Peterson, Wellman, & Liu, 2005; Wellman & Liu, 2004). It is the order listed above, with diverse desires easiest and hidden emotions hardest. For shorthand, I call this sequence, DD>DB>KA>FB>HE. This sequence is highly replicable and significant—80% of these children showed this pattern. A similar but slightly different sequence captures the progressive understanding of children in China and in Iran (Shahaeian, Peterson, Slaughter, & Wellman; Wellman, Fang, Liu, Zhu, & Liu, 2006). Thus, this ToM Scale establishes a progression of conceptual achievements that pace theory-of-mind understanding in normally developing children, as well as a method for measuring that development (a method validated with longitudinal data, as well; Wellman, Fang, & Peterson, 2011). Moreover, assessing a progression of ToM insights, both within and beyond the preschool years, helps researchers address how ToM impacts children's educational lives and achievements.

A Six-step ToM Scale. Beyond normatively «preschool» ToM milestones, for thinking about children and schooling, it is important to consider possible ToM advances for older, school-age children. Several tasks have been devised to also measure these later ToM insights (e.g., «strange stories,» Happe, 1994; a «silent film task,» Devine & Hughes, 2013; «second-order false-belief» tasks, Perner & Wimmer, 1985; a «reading the mind in the eyes» test, Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001). In our work, we reasoned that sarcasm and other forms of nonliteral conversation (e.g., teasing, exaggeration, ironic commentary) require an especially important everyday social understanding, and an understanding increasingly important to school-age children. Indeed, several studies have shown that conversational skills with jokes, sarcasm and other forms of oral humor predict peer popularity and social adjustment in both children (e.g., Wentzel, 2003) and adults (Wanzer, Frymier, Wojtaszczyk, & Smith, 2006). So, to create an extended, six-step ToM Scale we added an item tapping sarcasm understanding to the original five-step ToM Scale. Research has shown that this six-step ToM Scale does effectively assess a developing progression of ToM insights that extends to older children (8- to 13-year-olds) and even in some cases adults (O'Reilly, Peterson, & Wellman, 2014; Peterson, Wellman, & Slaughter, 2012). This extended scale thus provides one effective way to test school-age children. Even if the scale is not used, it points to several sorts of post-false-belief items (e.g., Hidden Emotion and Sarcasm) that can be used for testing ToM in school-age children.

Transition to school

To begin to think about ToM in relation to school-age children's transition to school, researchers must consider both their school readiness—the cognitive and social skills that children need to use and learn when they enter school—as well as their school learning. How might ToM matter for school readiness and school learning? Table 2 provides an organized outline for addressing these questions more systematically. ToM could influence children in school by impacting their social circumstances within school settings, such as whether they are accepted by their peers (or friendless), or whether they adopt classroom leadership roles (or merely follow along). Indeed, the preschool data have already begun to show that ToM does influence children's peer situations, at least before they enter formal schooling. More directly, ToM could influence children's performance on their academic tasks—reading, writing, mathematics—and the strategies children use (or fail to use) to achieve academic success. Finally, academic success (or lack thereof) depends not just on children's academic skills, but also on their persistence in school and on school tasks even in the face of challenges and failures. Moreover, academic progress requires students to be receptive to their teachers' instruction and feedback. Suppose we consider these additional skills and traits altogether and call them academic motivation; then, ToM could additionally impact children's academic motivation.

Table 2
Outline of potential influences of theory of mind on children in school

School social circumstances
- popularity/rejection
- leadership, joining in
Academic performance and strategies
- reading, writing, math
- history, social studies
- metacognition
Academic motivation
- persistence, overcoming failure
- sensitivity to teacher feedback

What follows is a review of contemporary studies that show that and how theory of mind influences children's school readiness and learning. This is not a systematic and exhaustive review. I selected studies that exemplify the various influences outlined in Table 2 and moreover were published in peer-reviewed journals by knowledgeable researchers. I particularly sought and reviewed studies that use current theory-of-mind measures that go beyond false-belief assessments alone and often use tasks from or tasks very like those just outlined as forming the basis of an extended scale that assesses a progression of developmentally accumulating theory-of-mind insights. Finally, the studies covered include researchers and classroom situations that come from a variety of locales, and not just the United States.

Impact of ToM on children's classroom social circumstances

Several studies address the influence of ToM on children's positive social relationships with their peers and with their teachers. To illustrate some of the relevant findings, first consider a recent study by Peterson, Slaughter, Moore, and Wellman (in press).

In a recent meta-analysis, Virginia Slaughter and her colleagues (Slaughter, Imuta, Peterson, & Henry, 2015) reviewed the research on ToM's relation to peer acceptance and popularity. They find that, summing over many studies and controlling for numerous background factors, better ToM consistently and significantly predicts better peer acceptance, and does so if peer acceptance is measured by soliciting ratings from children themselves or ratings from children's teachers. In the Peterson et al. research, my colleagues and I looked beyond children's peer acceptance alone to address their «peer social maturity» more broadly, including their leadership and skills for joining in. As shown in Table 3, we did this by using a recently created Peer Social Maturity Scale (PSMAT; first validated in Peterson, Slaughter, & Paynter, 2007) which had children's teachers rate them on seven different social skills.

Table 3
Peer Social Maturity (PSMAT) items

Judged by child's teacher on a 7-item response scale (1 = very far behind average child this age; 7=very far ahead of average child this age)*

Skills for appropriately standing up for own opinions, needs and rights with peers
 Skills for joining new groups of peers, or welcoming a new child into the group
 Leadership skills with peers
 Skills for coping with peers who frustrate or interfere with the group's goals and activities
 Skills for understanding the needs and interests of peers who differ from the group norm
 Maturity in everyday modes of playing with peers
 Overall maturity of the child's social skills

*Scores could range from a minimum of 7 (very far behind average child this age in all aspects of social maturity) to a maximum of 49.

Peterson et al. (in press) tested more than 100 children aged 6 to 13 years on a variety of ToM tasks that included a false-belief battery (three tasks) plus the six-item ToM Scale. For control purposes, language competence was assessed by either the Peabody Picture Vocabulary Test (PPVT) or the Clinical Evaluation of Language Fundamentals (CELF).

Fifty-three of these children were typically-developing children, and those children's PSMAT teacher ratings averaged 29 and ranged from 10 to 47 (where a maximum score would be 49; see Table 3). For them, ToM predicted social maturity ($r = .40, p < .01$), even with age and language competence partialled out. In this study, then, as well as in others (Garner & Waajid, 2008), ToM helps children develop positive relationships with their peers and, moreover, with their teachers. These positive relationships, in turn, foster academic progress (Buhs & Ladd, 2001; Rubin, Bukowski, & Parker, 2006; Wentzel, 2003). Lagatutta, Hjortsvang, and Kennedy (2014) provide a good, recent review of the relationship between positive school-based social relations (with peers and with teachers) and enhanced academic performance at school.

Typical and atypical children. School readiness in this social sense is not only important for children with typical development but also for those with atypical development, or children with developmental delays. It is well known that false belief understanding is seriously delayed in children with autism. Most adolescents and adults with autism perform poorly on false-belief tasks (e.g., Baron-Cohen, 1995). However, autism makes a difficult example for thinking about children's ordinary development and learning within school settings, because autism is replete with neurological impairments and general across-the-board cognitive impairment and delays. A more telling test-case concerns deaf children, because deaf children do not suffer from the same central neurological impairments and retardation as individuals with autism; they have peripheral hearing loss instead.

Deafness. Moreover, there are two informative groups of deaf children to consider. Deaf children of deaf parents grow up with ordinary conversational, language experiences —albeit in sign language— and so grow up with others who communicate and interact with them profusely. But most deaf children —about 90 to 95%— are born to hearing parents. They grow up with very different early experiences. For example, despite valiant efforts to learn sign, hearing parents rarely achieve real proficiency. Especially when their child is young, hearing parents mostly communicate with their deaf child using simple signs or gestures to refer to here and now objects (Lederberg, Schick, & Spencer 2013; Moeller & Schick, 2006). Also, usually only one person in the family —often the mother— is the «designated» primary communicator and interactor for the child. The deaf child in a hearing family begins with little discourse about persons' inner states, thoughts, and ideas, is likely to have restricted play with others, and generally have less access to the free-flowing, turn-taking, perspective-shifting interchange of social interactions.

Deaf children of hearing parents (but *not* deaf children of deaf parents) are substantially delayed in understanding false belief, often as delayed as high-functioning children with autism (see the review by

Peterson, 2009). Again, however, a focus on false belief alone is limiting. More informatively, when deaf children (of hearing parents) receive the ToM Scale, they too evidence a consistent sequence of progression, but one that is delayed at every step along the way. Table 4 shows some aggregated scaling data for deaf children of hearing parents. It is clear in that table that it takes deaf children of hearing parents 12 or more years to progressively achieve what hearing children (and deaf children of deaf parents) achieve in four to six years. For example, it is only at around 11, 12, and 13 years of age or older that they understand false belief. These are serious, consistent, delays that accumulate sequentially. And note, because deaf children of hearing parents are delayed, research with them using «preschool» ToM tasks is actually often with school-aged children being educated in classroom situations. Deaf children make a transition to school too; many are increasingly mainstreamed in regular classrooms, and others are educated in special classes or even schools for the deaf.

Table 4
Average ages (in years) of children for increasing scores on the ToM Scale^a

ToM Scale Scores ^b	0	1	2	3	4	5
U.S. and Australian preschoolers: (N=280)	3.22	3.66	3.84	4.45	4.77	5.15
Deaf children of hearing parents: (N=66)	8.77	7.83	7.92	9.88	11.31	12.40

^a Data for U.S. and Australian preschoolers were obtained from Wellman and Liu (2004); Wellman and Liu (2004); Peterson, Wellman, and Liu (2005); Wellman et al. (2008); and Peterson and Wellman (2009). Data for deaf children of hearing parents are from Peterson et al. (2005) and Peterson and Wellman (2009).

^b Scores range from 0 to 5 where 0 means the child fails all five tasks, 1 means they pass DD, 2 means they pass DD and DB, and so forth.

With this background, return to the Peterson et al. (in press) research on ToM and peer social maturity. In that study we not only tested typically-developing, hearing children, but additionally 54 deaf children of hearing parents who also ranged in age from 6 to 13 years. These children's PSMAT ratings averaged 20 (ranging from 7 to 31), significantly less than their age-matched typically-developing peers. But for these children too, ToM predicted social maturity measured via the PSMAT ($r = .27, p < .05$), and again did so even with age and language competence partialled out.

These data with deaf children thus further confirm that ToM helps children develop positive relationships with their peers and their teachers; it does so even when ToM itself is delayed. And, to reiterate, these positive relationships foster academic progress.

Academic performance and strategies

Does ToM also impact children's academic performances more directly? Conceptually, the rationale for thinking that ToM may do so is that ToM targets children's understanding of minds, including their own minds. Considering the belief-desire-action reasoning outlined in Figure 1, it is clear that ToM includes understandings such as the idea that people acquire knowledge and beliefs, and that certain factors influence and limit the acquisition of knowledge and beliefs. In short, ToM includes notions about memory and learning, as well as about beliefs and desires, more specifically. Thus, one aspect of ToM arguably includes knowledge about how to use one's mind. That is, considered broadly, ToM frames children's background understandings that the mind is limited, that the mind is the repository of learning, and that efforts can be made to overcome limitations and facilitate understanding, remembering, and learning. Additionally, such ToM understandings could shape children's awareness of that and how others can influence one's mind. For example, others can demonstrate new procedures and strategies, or provide information and knowledge. In this way, ToM potentially includes knowledge of learning in the additional sense of receiving teaching. Notice my constant use here of terms like «potentially» and «arguably.» All of these education-relevant possibilities are hypotheses, needing empirical data to confirm or disconfirm them.

Return to Table 2 that outlines various avenues for ToM's possible impact on education. To begin to assess if, where, and how ToM actually impacts children's academic performance and strategies, first consider the last subtopic noted in Table 2 under the heading of academic performance and strategies, the topic of metacognition.

Metacognition. Metacognition refers to children's knowledge *about* cognition, including especially their knowledge of cognitive difficulties plus knowledge of strategies for enhancing cognition and learning. Thus, metacognition is a topic often considered by researchers in addressing children's learning within school situations (see Schneider, 2015, for a review). There are several varieties of metacognition, but because when children go to school, they face increased demands for remembering, one specifically school-related form of metacognition is metamemory.

Metamemory. Metamemory concerns children's knowledge of learning and learning strategies in the sense of remembering information that is presented. Metamemory is often studied in younger children, such as those just beginning the transition to school, as was true in seminal research by Wolfgang Schneider and his colleagues (Lockl & Schneider, 2007). In a longitudinal study of 170 German children, these researchers assessed children's metamemory—their knowledge of memory difficulties and memory strategies—in standard ways (using tasks created for the Munich Longitudinal Study of Schneider, 2015; Weinert & Schneider, 1999) by asking children to judge different memorization scenarios. For example, children were asked: «If you had to remember a list of items, what would be harder, studying only a short time versus a long time?»; «If you had to remember a list of items, what would be harder, having lots of items to study or just a few?» Besides being asked about memory difficulties, children were also asked about memory strategies. For example, «If you had a list of names to remember, what would be better, studying in any old order or ordering the items in some meaningful way?»

ToM was assessed by several false-belief tasks and some other ToM items suitable for younger children, like those used in the Wellman and Liu (2004) ToM Scale. And again, for control purposes, language competence was assessed as well.

Better ToM at 3 ½ and 4 ½ years of age longitudinally predicted better metamemory at age 5 ½, that is, at the end of the kindergarten year, when children would transition to school the following year. This was true even when language competence was controlled ($beta = .20, p < .01$ for the prediction from ToM 3 ½ to metamemory at 5 ½ years, and $beta = .40$ for the prediction from 4 ½ to 5 ½ years). Moreover, this relation between ToM and metamemory holds in other studies of young children, too (e.g., Ebert, 2015; Lecce, Demichelli, Zocchi, & Palladino, 2015).

Meta-knowledge of reading. Serena Lecce and her colleagues have recently undertaken a number of studies relating ToM and academics, and one went beyond metamemory and beyond younger children to address a different form of metacognition—meta-knowledge of reading. In this research, Lecce, Zocchi, Pagnin, Palladino, and Taumopeau (2010) conducted a longitudinal study of 196 Italian children first tested in second and then again in fourth grade.

ToM was tested using false-belief tasks, but also in order to test advanced ToM, by using additional items and tasks like those in the six-step ToM Scale reviewed earlier. Meta-knowledge of reading was assessed (in fourth grade) by having children judge aspects of reading. For example, an item testing knowledge of the main aim of reading asked children to evaluate the idea that: «When you read, the most important thing is to understand the content of the text (not to read quickly or to read out loud).» An example testing knowledge of reading strategies asked children to evaluate: «If you need to really remember/understand a passage, it is better to read it several times (not simply underline and go on, or study with TV on).»

ToM at second grade longitudinally predicted meta-knowledge of reading at fourth grade. And this was true even with language competence and meta-knowledge of reading at fourth grade controlled ($beta = .37, p < .01$).

Academic performance. What about research more directly related to academic performance, such as children's reading and math or their overall school achievement? In several overlapping articles Lecce and her colleagues (Lecce, Caputi, & Hughes, 2011; Lecce, Caputi, & Pagnin, 2014) have reported results

from a longitudinal study of 60 children tested at 5 ½ years of age, and again at fifth grade —i.e., at 10 years of age.

ToM at 5 ½ years was measured by a six-task composite of false-belief tasks and other tasks taken from the five-step ToM Scale. Academic performance at fifth grade was assessed by tests of reading comprehension and math ability, as well as a teacher rating of the child's overall academic achievement. The direct measure of reading comprehension had children read a passage and answer 10 multiple choice questions about it. Math ability was measured using nine items, three each for number judgment, number ordering, and number coding. And teachers' rating of school achievement was assessed by using the Academic Sub-scale of the Social Skills Rating System (SSR). Verbal ability was included as a covariate and was measured by children's scores on the PPVT at 5 ½ years.

ToM at 5 ½ years predicted 10-year-old academic performance (with verbal ability and 10-year-old ToM controlled), $\beta = .55, p < .00$. Indeed, in a regression model, ToM at 5 ½ years accounted for an additional 13% of the variance ($\Delta R^2 = .13, p < .0001$) after age, verbal ability at 5 ½ years, and ToM at 10 years (controlling for concurrent ToM) were entered first. In short, early ToM competence directly predicted later academic performance, even with other relevant factors controlled.

To be fair, not all research shows such tight connections between ToM and academic outcomes. For example, Strasser and Del Rio (2013) tested a sample of 257 Chilean kindergarteners on their comprehension and recall of child-appropriate wordless storybooks (a task arguably related to later reading comprehension). And they examined the relations of such story comprehension to theory of mind (measured by a Spanish version of the six-step ToM Scale), and also to children's comprehension monitoring (a form of online metacognition), vocabulary, working memory, and executive functions (particularly inhibitory and attentional control). Theory of mind significantly predicted children's story comprehension and their comprehension monitoring in initial correlation analyses. But so did children's vocabulary and working memory. In a regression analysis including all of these predictive factors at once, theory of mind no longer surfaced as a significant independent predictor of story comprehension, whereas vocabulary and working memory did. Thus, in this study, the influence of theory of mind on comprehension and recall of a wordless picture book was subsumed under language and memory measures.

Academic motivation

Return to the Lecce, Caputi, and Pagnin (2014) research that did show longitudinal impact of ToM on children's reading, math, and overall academic achievement. This same study provides a good example for the last major topic outlined in Table 2, academic motivation. Specifically, in this research, ToM competence also further influenced academic performance, through its impact on children's *sensitivity to teacher feedback*.

Sensitivity to feedback has been measured in past research using scenarios acted out with a teacher puppet and a child puppet (Heyman, Dweck, & Cain, 1992), and this was the method used by Lecce and her colleagues. In this assessment a child puppet completed a math problem of writing the numbers from 1 to 20. Overall the child puppet did well—correctly writing 19 of the 20 numbers—but it left out number 7. The teacher puppet found this error and provided feedback, saying, «You left out number 7. That is not what I call writing numbers the right way.»

Children were asked to imagine they themselves had written numbers and left one out, and were asked to assign their work a grade (a plus or a minus) and to rate their own math ability as «good» or «not good.» They were given one point for giving themselves a grade of minus and one point for rating their ability as «not good,» with higher scores showing greater sensitivity to the teacher's feedback (feedback given to the puppet in the task example). ToM at age 5 ½ years of age predicted sensitivity to teacher feedback at 10 years ($r = .49, p < .0001$). And sensitivity to teacher feedback correlated to school achievement ($r = .26, p < .05$).

Recall that in the regression model predicting academic performance, reported earlier, ToM at 5 ½ years predicted later academic performance, even with language competence, age, and ToM at age 10

controlled ($\Delta R^2 = .13, p < .001$). At this point, all these factors accounted for 38% of the total variance in children's academic performance at age 10. Then, sensitivity to teacher feedback was entered as an additional and last step in a total regression model. Sensitivity to teacher feedback helped account for still more variance in predicting 10-year-old academic performance ($\Delta R^2 = .06, p < .10$). In sum, the final analysis including sensitivity to teacher feedback accounted for 44% of the total variance in children's academic performance. So, ToM at age 5 ½ not only predicted academic performance at age 10 more directly, it also additionally predicted academic performance through its significant influence on sensitivity to teacher feedback, which also predicted children's academic performance.

It is important to point out that children's receptivity to their teachers' comments can be seen as having both negative and positive influences. In the Lecce et al. (2014) study, receptivity to teacher feedback, as I have labeled it, predicted *improved* academic performance over time. However, Lecce and her colleagues called this measure «sensitivity to criticism,» and, following Judy Dunn's (Cutting & Dunn, 2002; Dunn 1995) theorizing, began by predicting a negative relation. Their thinking was that theory of mind heightens children's sensitivity to their teachers' and peers' critical comments, and that this could be detrimental to academic performance. Indeed, in prior research, person-oriented criticism (where an adult criticizes the child, e.g., «You're not very good at math») as opposed to process-oriented criticism («You failed to carry from the 10s place») appears to increase children's learned helpfulness and so decreases their effective, persistent performance. In this way certain types of criticism foster an entity theory (intelligence and learning potential are fixed and limited) rather than an incremental theory (intelligence and learning potential can be increased with effortful tackling of harder problems) of their own abilities (e.g., Elliot & Dweck, 2005; Kamins & Dweck, 1999). Thus, the influence of teacher feedback to students is complex, depending on the type of feedback provided (praise vs. criticism, person-oriented vs. process-oriented). The influence of teacher feedback also depends, as the Lecce et al. (2014) research shows, on children's theory of mind.

Training theory of mind itself

With all this, it is worth asking whether ToM can be enhanced in instructive situations. Can children be educated about ToM? Moreover, intervening to change children's ToM provides an important complement to the research described thus far. This is because correlations, even longitudinally predictive ones, cannot prove direct causal relationships. To explore mechanisms of development, experimental intervention or training studies are needed to complement longitudinal data (see Bradley & Bryant, 1983). Thus, training ToM provides a way to assess its impact on children's lives and educations more experimentally.

Explanation as a mechanism for theory-of-mind change

Many training procedures have now been demonstrated to help change theory of mind understandings. Some utilize and promote children's use of representational devices, such as language and thought bubbles (e.g., Wellman & Peterson 2013); some focus on parents talking to their children (e.g., increasing certain forms of parental talk to children increases children's ToM; Taumoepeau & Reese, 2013), some provide simple feedback to children, for example, on false-belief tasks (e.g., Hale & Tager-Flusberg, 2003); and some employ combinations of these features (Ding et al., 2015; Lohmann & Tomasello, 2003). I will concentrate on one approach here, chosen because this approach employs a method for inducing change that has larger educational promise. Moreover, using this method, my collaborators and I have gone beyond training that produces «small» changes (e.g., training on false-belief tasks whose impact is limited to correctly answering similar false-belief tasks) to achieve more widespread changes in children's ToM understanding.

The key feature of this ToM training is that it rests on eliciting children's own explanations of actions and events. It does this via ToM training that employs multiple «microgenetic» sessions. To elaborate briefly, microgenetic studies are a special type of longitudinal study where researchers sample behavior very frequently to obtain a fine-grained picture of developmental change. Further, to experimentally capture change, some microgenetic research involves not just measuring change but accelerating it, and in particular, designs where investigators «choose a task representative of the cognition in question,

hypothesize the types of everyday experiences that lead to change, and then provide a higher concentration of these experiences than ordinary» (Siegler, 1995a, p. 413).

Following this thinking, in our studies, we began by using false belief as «a task representative of the cognition in question,» and then hypothesized that explaining peoples' actions is a type of everyday experience that leads to ToM advances in the ordinary course of ToM development (Wellman, 2011). Thus we had children undertake a «higher concentration» of such explanatory experiences over multiple days. A brief description of an initial study (Amsterlaw & Wellman, 2006) illustrates this approach.

That study began with young 3-year-olds for whom a pre-test showed that they systematically failed numerous false-belief tasks as well as several other theory-of-mind tasks. Research of the kind outlined in Figure 2 shows that, in the course of everyday development, it takes such young children considerable time to go from consistent false-belief errors to consistent correct performance (e.g., Wellman et al., 2001). Indeed, in Amsterlaw and Wellman (2006), in a control group that received only pre- and post-tests, after 10 to 12 weeks, children of this young age made virtually no progress in false-belief understanding. Moreover, when another group of 3-year-olds who consistently failed false belief at the pre-test stage received repeated false-belief tests over multiple weeks—not just a pre- and post-test—they made little progress. This was the comparison group.

To describe this further, children in this comparison group received multiple false-belief tasks in two sessions a week for a total of 12 sessions. For these tasks, they had to predict what would happen in a false-belief scenario, and then were shown what actually happens. For example, as illustrated on the left in Figure 3, children had to predict where Max would look for a Band-Aid. Because these were young children pre-tested to consistently fail false-belief tasks, they predicted that Max would go directly to the unmarked, plain box. Then they were shown that Max actually went to the Band-Aid box (with nothing further said after that). So, children made their predictions and were given implicit feedback. In spite of these multiple experiences with false-belief tasks, including implicit feedback for their consistently wrong choices, children did not improve.

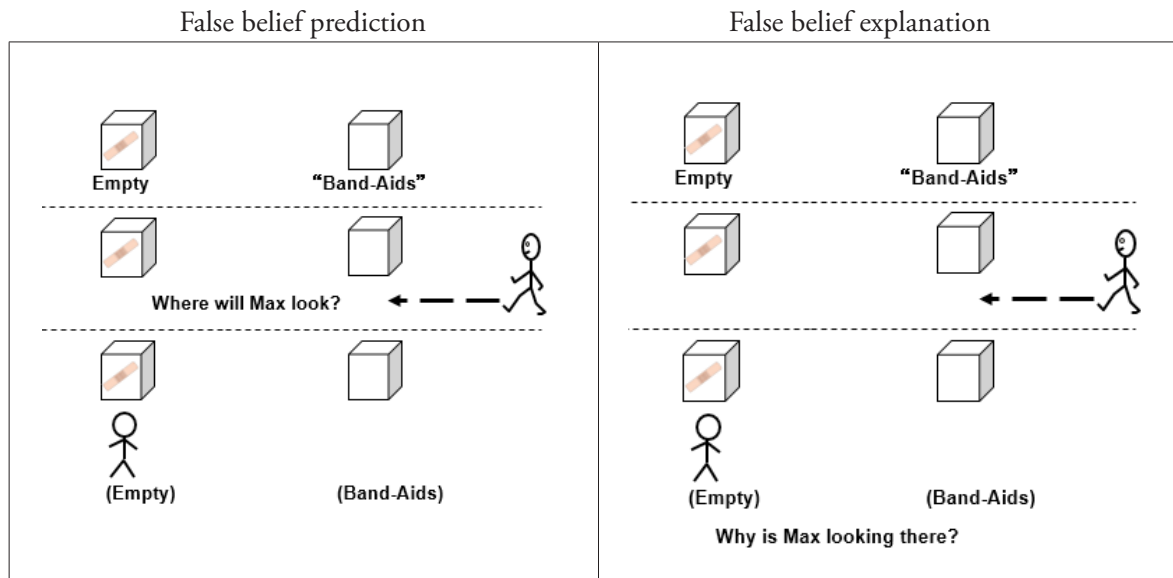


Figure 4. Parallel prediction (left panel) and explanation (right panel) tasks of the sort used in Amsterlaw and Wellman (2006); Rhodes and Wellman (2013); and Peterson and Wellman (in preparation). In both tasks children receive implicit feedback about their predictions of where the character would look, by seeing where the character actually looks (and no other feedback, verbal or non-verbal). In addition, in the explanation task children were asked to explain the character's actual (false-belief driven) behavior (but given no feedback on the nature or correctness of their explanation).

Focally, however, in Amsterlaw and Wellman (2006; see also Rhodes & Wellman, 2013), a comparable group of young children who consistently failed false belief were required to make both false-belief

predictions and also explanations again and again over many weeks. This was the focal Microgenetic group. In two sessions a week for a total of 12 sessions, they had to predict what would happen in various false-belief scenarios (e.g., predict where Max would look for a Band-Aid); they were then shown what actually happens (Max went to look in the Band-Aid box), and asked to explain the character's action (Why did Max do that?). This is outlined on the right of Figure 4.

The rationale for providing a higher concentration of these explanation experiences rested on data from earlier research showing that in their everyday conversations, parents and children frequently ask for explanations of persons' actions (e.g., Hickling & Wellman, 2001). Moreover, variability in the frequency of explanations during everyday family conversations predicts individual differences in children's social-cognitive understanding (Dunn & Brown, 1993; Peterson & Slaughter, 2003; Ruffman, Slade, & Crowe, 2002).

In this Microgenetic group, there was significant improvement relative both to a pre-test (that children consistently failed) and to the two control groups (where consistent failure persisted). Children in the focal Microgenetic group went from initially making consistent false-belief errors (being incorrect 88% of the time) to later being consistently correct (performing correctly 75% of the time). At post-test, children in the explanation condition significantly outperformed the comparison and control groups on false-belief explanation tasks, and on prediction tasks as well. Moreover, only the explanation group succeeded on a transfer problem of a sort that had never appeared in training. In sum, the explanation group developed and learned; the comparison group received an equivalent number of false-belief problems, and received corrective implicit feedback, but learned no more than the control group.

Other studies have shown that children who receive these microgenetic training regimens continue to do better on ToM tests months after training has ceased (Rhodes & Wellman, 2013; Wellman & Peterson, 2013). Moreover, in a recent study, Peterson and Wellman (in preparation) showed that training school-age deaf children via microgenetic explanation procedures enhances their ToM understandings, as well.

Explanation and educational outcomes

It is worth emphasizing that the critical ingredient in this research was to have children explain for themselves others' actions and thinking (not simply receive explanations from others). In this way, the research reflects the power of children's «self explanations.» This research contributes to a body of findings that shows not only that explanation is important to children, but also that it is important to educational practices, as well. For starters, self-explanation studies in other domains, such as mathematical reasoning, also find that explaining fosters learning more effectively than only receiving feedback. In early research of this sort, Robert Siegler (1995b) took three groups of 5-year-olds who initially failed Piagetian conservation of number tasks (e.g., shown two rows of six aligned counters that they initially judged to be equal, they judged one row to now have more counters if it was simply re-aligned to be longer), and trained them on multiple conservation tasks over successive sessions. Children in a *feedback-only* group were corrected on their judgments by an experimenter (e.g., «No, actually the two rows have the same number»). The *explain-own* reasoning group was asked to explain their judgments (e.g., «How did you know that?»). An *explain-experimenter's* reasoning group was corrected by an experimenter («Actually the two rows have the same number»), then asked to explain the experimenter's reasoning («How do you think I knew that?»). Children in the *explain-experimenter's* group out-performed and out-learned the others; by their final session, children in that group were 70% correct on conservation tasks, whereas in the other groups, children were 40% correct or less.

Instructional psychology studies with older children and adults show that in learning from text or examples, explaining novel information to oneself facilitates learning (e.g., Chi, De Leeuw, Chiu, & Lavancher, 1994; Williams & Lombrozo, 2013). In these further self-explanation studies, the learner's task is typically to understand a textbook passage, a set of examples, or a class-related demonstration, and the instructional manipulation is to have students not merely read, listen or attend, but to explain the author's or the instructor's reasoning («How do you think I knew that?»). Such explanation manipulations are a more effective learning strategy than merely receiving feedback (Aleven & Koedinger, 2002), and more effective than thinking out loud (Pine & Siegler, 2003; Wong, Lawson, & Keeves, 2002) or reading study materials twice (Chi, De Leeuw, Chiu, & Lavancher, 1994), manipulations designed to parallel any

extra attention and processing required in self-explanation. Micheline Chi (2009) provides a review of many such studies.

In these self-explanation studies, generating explanations also influences generalization and transfer. For example, school-age students who received practice on addition problems were more likely to succeed in solving transfer subtraction problems if prompted to explain the earlier addition materials (Rittle-Johnson, 2006). Self-explanation, then, aids students' learning of primary material (such as history, math, science, and stories). Self-explanation also aids children's ToM learning (as shown in our microgenetic research) which in turn also affects their classroom learning (in the ways reviewed throughout this article).

Discussion

To conclude, theory of mind captures crucial social cognitive understandings. Theory-of-mind achievements and advances begin in early childhood, but continue for years after, including when children transition to formal schooling. Theory of mind influences children's everyday life, including children's lives in school and school situations. Theory of mind influences school outcomes indirectly by impacting children's social circumstances within their school, such as their popularity with and acceptance by their peers and their engagement in school-based leadership roles. Relatedly, theory of mind influences children's receptivity to various teacher– student interactions, such as when a teacher provides feedback or criticism on their work. In addition, theory of mind influences school outcomes by influencing children's metacognition, as well as their reading competence, math abilities, and comprehension strategies that lead to better performance and learning. Moreover, theory of mind shapes children's explanations and interest in explanations, including their explanation of persons' actions, as well as explanations of instructional communications. Self-explanation of persons' actions, instructions, and writings helps promote understanding of, and learning from, instruction and instructional materials.

This review of research also suggests several directions for future research. First, given the promising research described here, more research on how ToM advances impact children's educational achievement is warranted. Future research should concentrate on longitudinal studies that span the transition to children's entry into and development within school settings. Moreover, more research is needed where children's theory of mind skills are targeted via educational interventions. Only these studies can assess whether such ToM interventions improve children's social lives and academic performances in ways that matter. And only such intervention studies can create procedures that teachers could practically adopt.

The research reviewed here suggests several topics for such research and educational efforts. One would be theory-of-mind «lessons» designed to facilitate children's transition to the heightened challenges of peer group interaction within elementary school situations. Similarly, ToM lessons could be designed to facilitate children's socially-informed strategies for and receptivity to their teachers' instruction and feedback. Further research on how to utilize the power of self-explanations within elementary school classroom pedagogy would also be helpful. These are just three examples among several that could begin to fill in the several steps that still exist between promising initial research and practical, effective educational programming.

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