Published in final edited form as:

Soc Dev. 2012 May ; 21(2): 313–330. doi:10.1111/j.1467-9507.2011.00638.x.

The Developmental Progression of Understanding of Mind during a Hiding Game

P. Brooke Nelson, Lauren B. Adamson, and Roger Bakeman

Georgia State University

Abstract

In this longitudinal study, 52 typically developing preschoolers engaged in a hiding game with their mothers when children were 42-, 54-, and 66-months old. Children's understanding of mind, positive affect, and engagement with the task were rated, and mothers' utterances were coded for role and content. Analyses confirmed that some facets of children's understanding of mind developed sequentially; specifically, they expressed an understanding of knowledge access before an understanding of deception and false beliefs, and expressed an understanding of deception before an understanding of false beliefs. Children's understanding of mind increased across visits and positively correlated with false belief task performance. Results suggest that mothers may tailor the content of their utterances to the child's growing expertise, but the role of mothers' utterances did not change. Observing preschoolers engaged in a playful hiding game revealed that children's understanding of mind not only increased with age but also developed sequentially.

Children come to know other minds during shared engagement that allows for intimate, affective exchanges with others (Carpendale & Lewis, 2004; Hobson, 1993; Reddy, 2008). Broadly, shared engagement gives children access to their culture's tools (Vygotsky, 1978) and affords them the opportunity to learn ways of interacting with others (Bruner, 1983). When children enter into affective, interpersonal engagement with their caregivers, they gain access to the human environment and benefit from having their caregivers guide them (Adamson, 1995). More specifically, when children engage in triadic interactions with a caregiver and an object, they have the opportunity to learn about the person as well as the object, and these shared experiences facilitate theory of mind development (Charman et al., 2000; Nelson, Adamson, & Bakeman, 2008). Additional aspects of children's social experiences, such as social discourse in the family (Ontai & Thompson, 2008; Ruffman, Slade, & Crowe, 2002; Symons, Fossum, & Collins, 2006), mother's mind-mindedness (Meins et al., 2002), and even how siblings resolve conflicts (Randell & Peterson, 2009) are also related to theory of mind development.

Despite substantial evidence linking the child's engagement within the social world to the development of an understanding of mind, most theory of mind studies have looked exclusively at the child's understanding during experimenter-led false belief tasks (Wellman, Cross, & Watson, 2001). Few studies have observed children in social interactions to study

theory of mind development (Carpendale & Lewis, 2004), and none have assessed the child's understanding of mind within such interactions. This omission leaves unanswered the important question of how children use their understanding of mind during social interactions. Assessing children's expression of their understanding of mind while engaged with caregivers provides an important complement to the study of theory of mind in structured false belief tasks because it can further our understanding about how children express and caregivers support the emerging, multifaceted understanding of mind. In this longitudinal study, typically developing preschoolers engaged in a hiding game with their mothers that mimicked a traditional false belief task of changed location (Wimmer & Perner, 1983) in a semi-structured play setting.

The Child's Understanding of Mind

Many childhood games such as hide-and-seek are funny and exciting (Peskin & Ardino, 2003), and our main goal was to create a similarly playful, social context during which we could observe several facets of the child's understanding of mind. Our hiding game included many of the elements of hide-and-seek (i.e., the mother and child hid the experimenter's toys and then anxiously waited for her return in order to see their trick fulfilled) but was unique in that it allowed us to systematically observe the child's expression of understanding of knowledge access, deception, false belief, and belief-based emotions.

Understanding how an individual gains the knowledge that makes up his or her subjective mind is a necessary precursor of more complex abilities (Wellman & Liu, 2004; Wimmer, Hogrefe, & Perner, 1988). The ability to deceive is arguably a rudimentary understanding of false beliefs (Hala & Chandler, 1996; Reddy, 2008) and especially interesting because of the positive impact deception has on younger children's abilities to correctly attribute false beliefs. Meta-analytic results suggest that if a false belief task included deception as a motive, younger children were more likely to answer false belief questions correctly (Wellman et al., 2001). False belief understanding is the social cognitive milestone that most regard as indicative of an adult-like theory of mind allowing individuals to make sense of and predict another person's actions even when that person may hold a belief that is incongruent with reality (Tager-Flusberg, Baron-Cohen, & Cohen, 1993; Wellman et al., 2001). The quintessential belief-based emotion is surprise; to be surprised one must hold a belief that is different from reality (Doherty, 2009). Past research suggests that children's understanding of surprise develops around age 6 after the child understands that others can hold false beliefs (Hadwin & Perner, 1991; Ruffman & Keenan, 1996).

In the current investigation we expected to see significant change in the children's understanding of mind across the preschool years with understandings of knowledge access, deception, false belief, and belief-based emotions developing sequentially. This means that in addition to expecting that children's understanding of mind would increase over the course of the study, we also expected that participants would make advances in their understanding of knowledge access before deception, deception before false belief, and false belief before belief-based emotion. As new understanding develops, previous understanding remains. We also expected that children would share positive affect with their mothers during the hiding game. Preschoolers seem to delight in the idea of trickery, particularly

hiding themselves (Peskin & Ardino, 2003) and perhaps objects from an unknowing experimenter. Caregivers and children often 'share funniness' (Reddy, 2008), and we anticipated that children would show heightened positive affect, sharing "knowing" smiles and laughter, as they enthusiastically engaged with their mothers in the trick.

Researchers' extensive use of and reliance upon false belief tasks during the study of theory of mind development makes it important that our observational assessment be validated against them. Research suggests that children's active involvement in planning a trick is related to their false belief understanding (Hala & Chandler, 1996; Peskin & Ardino, 2003), thus we expected that preschoolers' expression of their understanding of mind during the hiding game would be related to their false belief task performance.

The Mother's Support

Children have been observed in hiding games with both experimenters (Peskin & Ardino, 2003) and peers (Szarkowicz, 1999), but in all cases the individuals have been competitors. This study complements past research by including the caregiver, whose intimate, everyday experiences with the child gives her access to abundant information regarding her child's developing understanding of mind (Hutchins, Bonazinga, Prelock, & Taylor, 2008).

Our conceptualization of how a mother might support her child's emerging understanding of mind draws heavily on Vygotsky's (1978) theory of development in which a knowledgeable adult creates a 'zone of proximal development' in order to move the child towards mastery of a culturally important skill. The ability to understand minds is fundamental to the children's understanding of their social world (Tager-Flusberg et al., 1993; Wellman, 1990), and as such is an especially important skill for a caregiver to help her child develop. Thus, we expected that mothers would align their scaffolding during the hiding game to suit their child's current understanding of mind. Previous research shows that mothers may change the role of their utterances to be more or less directive depending on their child's abilities and experiences (McArthur, Adamson, & Deckner, 2005; Rogoff, Ellis, & Gardner, 1984). In line with these studies, we expected to see the role of the mother's utterances shift from more to less direct and more indirect as the child's understanding of mind developed. Prior research also suggests that mothers may tailor the content of their utterances to their children's expertise (McArthur et al., 2005), and thus we expected that they would use children's demonstrations of understanding in the hiding game to guide the content of their utterances as well. For example, if a child does not appear to understand knowledge access, the mother may attempt to scaffold this understanding rather than the even more advanced understanding of false beliefs.

To summarize, our intent in the current study was to move beyond traditional false belief tasks to capture preschoolers' use of understanding of mind as they interacted with their caregivers. Our hiding game was designed to be a playful context that would encourage children to use their emerging understanding of mind. We expected children's understanding of mind to increase with age, following a sequence in which understanding of knowledge access precedes understanding of deception which precedes false belief understanding which, in turn, emerges before belief-based emotion. We also expected mothers' support of

the child's understanding of mind would shift to align with their children's developing capabilities.

Method

Design

This study is part of a larger investigation of the development of joint engagement in young children (Adamson, Bakeman, & Deckner, 2004). Participants visited our laboratory for eight visits when they were approximately 18, 21, 24, 27, 30, 42, 54, and 66 months of age. The current report focused on the visits at 42-, 54-, and 66-months old. At each of these visits, the child and mother engaged in a hiding game as part of a multi-scene communication play, and children were administered a battery of false belief tasks as part of a larger assessment battery.

Participants

Participants were 52 mother-child dyads; children's ages averaged 42.1, 54.1, and 66.1 at each of the visits. Initially 56 full-term, typically developing toddlers were recruited from a pool of parents who responded to a call for volunteers for studies of child development; of those, 4 did not continue past the 30-month visit and are not part of the current study. Of the 52 that continued, 4 missed the 42-month visit and an additional dyad failed to enact the basic plot of the hiding game, 4 missed the 54-month visit, and 5 missed the 66-month visit. Participants were 27 boys and 25 girls; 40 were European American, 9 African American, and 2 Hispanic. Mothers averaged 32 years of age; all had completed high school and 38 had earned a bachelor's degree or higher.

Observational Procedures

All sessions were held in a laboratory playroom designed for observational research. Sessions were recorded by two cameras hidden behind one-way mirrored windows. Their two recordings were synchronized with a common vertical interval time code (VITC) so that coders select the best view of the interaction. Laboratory visits consisted of play observations and testing. Researchers explained to the mother that the primary interest of the study was to observe how her child was currently communicating. Following the play observations which included the hiding game, false belief tasks were administered. For more details regarding the play observations and procedures see Adamson and Bakeman (2000).

The Hiding Game

To begin the hiding game, an experimenter brought three toys into the room. Three sets of toys were counterbalanced across sessions. The child chose one toy with which to play. The experimenter then explained that she was putting the other two toys away and would come back to get them later. One toy was put in a covered box and a second was placed inside a cabinet. The experimenter named each object as she placed it in order to call attention to its location. Mothers were given a cue card that provided a brief statement of the hiding game plot and prompted them to encourage the child to take out the toys that were reserved for later and to hide them, and then to inquire about where the experimenter would believe the toys to be. Cue cards were the same at each visit. A script was not provided. Children

typically enthusiastically played along with the deception, giggling as they selected the best hiding spots and talking with their mothers about what the experimenter might know about the toys' locations upon her return.

After approximately five minutes had elapsed ($M = 5:08, 5:03, 5:01$; $SD = 0:11, 0:05$, and $0:06$, for the 42-, 54-, and 66-month visits, respectively), the experimenter returned to the room and asked the child where she left the toys and for help finding them. The follow up portion of the hiding game usually lasted approximately a minute and a half and ended when the experimenter found all of the toys. A random sampling of ten percent of the tapes was used to compute an average length, $M = 1:38$ ($SD = 0:48$).

False Belief Tasks

Two standardized false belief tasks were used: the changed location task (Baron-Cohen, Leslie & Frith, 1985; Peterson & Siegel, 1999) and the misleading container task (Perner, Frith, Leslie & Leekam, 1989; Welch-Ross, 1997).

In the changed location task, Sally placed her ball under a box and then went outside to play. While she was gone, her friend Mike played a trick on her and moved her ball from under the box to under a bucket. Sally then returned without having seen this switch. The child was then asked 3 questions about the situation: where Sally would look for the ball, what is the actual location of the ball, and where was the ball before Sally went out to play.

In the misleading container task, children were shown a familiar crayon box and asked what was inside the box. They were then shown the actual contents, birthday candles. The box was then reclosed. Children were asked about their own initial false belief about the contents of the box and about the naïve beliefs of another person, who had not seen inside the box.

Two researchers administered the false belief tasks, one in approximately one-third of the visits and the other in the remaining two-thirds. Three sets of props were used for the false belief tasks, counterbalanced across visits and children. Tasks were scored as they were administered; a pass was credited when a child answered correctly all the questions posed in the task. To assess reliability, the first author reviewed videotapes of the tasks and found no discrepancies.

A third false belief task, changed appearance (Leekam & Perner, 1991; Peterson & Siegel, 1999), was also administered. A large number of children (81% at 42-months; 48% at 54-months, 38% at 66-months) failed the control questions, which suggests that they did not understand this task. Consequently, responses to this task were not considered further.

Child Ratings during the Hiding Game

To characterize the child's understanding of mind, trained coders viewed video recordings of the hiding game and rated the child's understanding of knowledge access, deception, false belief, belief-based emotions, positive affect, and engagement with the task, 1 (low) to 5 (high). Coders did not rate the first four items if the observational evidence was deemed insufficient to assign a rating. Brief descriptions of each item are given below; a coding manual is available upon request.

Understanding of knowledge access—This item characterized the child's understanding that seeing leads to knowing. Ratings were based on behaviors that suggested an understanding that the experimenter's knowledge was based upon what she could see or hear (e.g., tiptoeing around the room while hiding the toys, consistently whispering to the mother, or discussing the experimenter's inability to see or hear what was occurring in the playroom during her absence). A low rating indicates no understanding of how a person comes to have knowledge (e.g., a child who did not whisper or tiptoe even when the mother demonstrated these behaviors). A high rating indicates a well-formed understanding of how someone gains access to knowledge (e.g., a child who spontaneously tiptoed and sustained his “quiet” while hiding the toys).

Understanding of deception—This item characterized the child's understanding of how to play a trick or deceive someone. Coders based their ratings on the child's ability to hide items, discussions about various hiding places, and the child's behavior once the experimenter returned. A low rating indicates no understanding of deception (e.g., a child who did not hide the toys or “hid” them in clearly visible places), whereas a high rating indicates a well-formed, sophisticated understanding of deception (e.g., a child who hid the toys well and planned how they would act when the experimenter returned to fulfill the trick without the mother's help).

False belief understanding—This item characterized the child's understanding that individuals may have beliefs that are incongruent with reality. Ratings were based on whether the child understood that the experimenter would think the toys were where she left them originally or the child's misunderstanding that the experimenter would know the new, hidden locations of the toys. A low rating indicates no false belief understanding (e.g., a child who had only flawed discussions that credited the experimenter with knowledge that she could not have had about the objects' location), whereas a high rating indicates a well-formed, adult-like understanding of false belief (e.g., a child who had rational discussions about the experimenter's false belief or offered a well-played false hint to her when she returned for the toys).

Understanding of belief-based emotion—This item characterized the child's understanding that certain emotions (e.g., surprise) are based on a person's beliefs. Ratings were based on the child's comments about how the experimenter might react to the trick. A low rating indicates no understanding of someone's emotional response to a false belief (e.g., a child who indicated having no idea how the experimenter may act when she finds out her toys are not where she left them), whereas a high rating indicates well-formed mature understanding of how someone might react to finding out a belief is false (e.g., a child who hypothesized how and why the experimenter may react a certain way).

Positive Affect—This item characterized the child's enthusiasm and excitement during the hiding game. Ratings were based on the child's vocal inflections, body language, and facial expressions. A low rating indicates that the child appeared bored, flat, or just not at all excited about the idea of hiding the toys from the experimenter (e.g., a child who sighed, frowned, and suggested it would be much more fun to put together a puzzle instead of hiding

the toys), whereas a high rating was given to a child who was overcome with excitement and seemed unable to contain her joy (e.g., a child who could barely talk to her mother because she was excitedly bouncing around the room and giggling about the idea of hiding the toys).

Engagement with the task—This item characterized the child's engagement with the task based on the child's attention to the mother and/or experimenter and overall participation. A low rating was given when the child actively tried to disrupt the activity and persistently resisted the mother's suggestions to hide the toys, whereas a high rating indicated that the child readily and enthusiastically participated.

Plot enactment—This yes/no code indicated whether or not a mother generally followed the plot of the scene. Coders based assessment on whether or not the mother suggested to the child that they get the toys out and hide them.

Maternal Scaffolding Codes

The coding unit was a maternal utterance as specified in the transcript of the mother-child interaction during the hiding game condition. These transcripts were available for the entire communication play. Transcribers identified each maternal utterance which was usually a verbal sentence or phrase, reflecting a single complete thought. More rarely an utterance was solely nonverbal, such as when the mother pointed to answer the child's question. Two or more transcribers contributed to each transcript so that both views of the video record informed the transcription and any discrepancies could be discussed before a final transcript was produced. A manual used by the transcribers (Adamson & Bakeman, 1999) is available upon request.

By consulting both the transcript and the videotape of the hiding game, two trained coders described each of the mothers' utterances. The coders' first task was to decide if the utterance was relevant to the task. If it was relevant, coders used mutually exclusive and exhaustive codes to describe the utterance's role and content, and whether nonverbal support accompanied the utterance. A coding manual is available upon request.

Coders decided if the utterance was *relevant* to the task. Utterances about the hiding game were considered relevant. Those that were not (e.g., *Let's put together this puzzle.*) were coded as irrelevant.

Next coders decided the *role of the utterance* (McArthur et al., 2005; Rogoff et al., 1984). Choices for role were statements (e.g., *She doesn't know we put it in there.*), imperatives (e.g., *Hide the doll under the pillows.*), tag or yes/no questions that required the child only to reply in agreement or disagreement (e.g., *Don't tell her anything when she comes in, alright?*), or open-ended questions (e.g., *What is she going to think is inside the cabinet?*).

Then coders identified the *content of the utterance* (McArthur et al., 2005) as focused on knowledge access (e.g., *She can't see us.*), deception (e.g., *Let's hide it under here.*), false belief (e.g., *Why will she think the ball is in the cabinet?*), or belief-based emotion (e.g., *Do you think she'll be surprised?*).

Coders also indicated whether or not *nonverbal scaffolds* accompanied the utterance. Nonverbal scaffolds included gesturing (e.g., pointing), exaggerated tiptoeing, or physically moving an object without the child's involvement, and helping the child move an object.

Coding Reliability

To assess reliability, the author coded 20% of corpus for the child's ratings and 15% of the corpus for mothers' utterances. Coders were unaware of which visits were used for reliability. For the child ratings, weighted kappas (Cohen, 1968) were computed using the ComKappa program (Robinson & Bakeman, 1998; 1-point disagreements counted 1, 2-point counted 2, etc.; see Bakeman & Gottman, 1997). Weighted kappas were .77, .97, .79, .87, .75, .85, and 1.00 for understanding of knowledge access, deception, false belief, belief-based emotion, positive affect, engagement with the task, and plot enactment, respectively. For the mothers' utterance coding, reliability was assessed by calculating Cohen's kappa (Cohen, 1960). Kappas were .89, .87, .83, and .75 for task relevance, role of utterance, content of utterance, and nonverbal support.

Results

Children's Understanding of Mind

Average ratings for children's understanding of knowledge access, deception, and false belief at each visit are listed in Table 1. All three ratings increased or remained the same for 81%, 88%, and 87% of the children, respectively (all significant linear trends per Cox-Stuart tests, $p < .01$). Moreover, children's ratings for knowledge access understanding were consistently higher than or equal to their ratings for deception and false belief understanding, and ratings for deception understanding were consistently higher than or equal to their ratings for false belief understanding for 83%, 88%, and 83% of children at the three annual visits (i.e., at 42-, 54- and 66-months), respectively (significantly different from chance per two-tailed sign tests, $p < .001$). Understanding of belief-based emotion was excluded from all analyses because 74%, 71%, and 68% of the participants could not be rated due to insufficient observational evidence at the three annual visits, respectively.

An understanding of mind composite score, expressed as a percentage, was formed by dividing the average of the three items by 5, the highest rating (for means see Table 1). Understanding of mind composite scores increased or remained the same across visits for 78% of the children (significant linear trend per a Cox-Stuart test, $p < .01$). Performance on false belief tasks also improved with age: 10%, 56%, and 74% of children passed both tasks at the three annual visits, respectively. Children who passed both had higher understanding of mind composite scores than other children at the first and second visits but not the third when the majority of children were at ceiling for both the understanding of mind composite score and false belief task performance ($M = 79$ vs. 58, 87 vs. 77, & 94 vs. 97; Mann-Whitney $U = 40.5, 156.5, \& 158.0$; n_{both} vs. $n_{one/two} = 5$ vs. 43, 27 vs. 21, & 34 vs. 12; $p = .03, .01, \& .21$, for the three visits respectively).

Average ratings for children's positive affect and engagement are also given in Table 1. Most children were enthusiastic (i.e., were rated 3–5) about the game at all visits; however, a

few children were described as indifferent (i.e., were rated 1–2). Enthusiastic children had higher understanding of mind composite scores than indifferent children at the first and second visits but not the third ($M = 62$ vs. 48, 87 vs. 54, & 95 vs. 90); Mann-Whitney $U = 54.0, 16.0, \& 20.5$; $n_{\text{enthusiastic}}$ vs. $n_{\text{indifferent}} = 41$ vs. 6, 42 vs. 6, & 45 vs. 2; $p = .03, .001, \& .22$, for the three visits respectively).

Children remained highly engaged with the task at all three visits. Most children readily participated in the trick, but 12, 2, and 3 children needed coaxing or encouragement from the mother to go along with the trick at the three annual visits, respectively. Engagement with the task was not significantly related to understanding of mind scores at any of the three visits, $r_s = .25, .22$, and $.22$, respectively. The missing data resulting from the use of the *not observed* code were noteworthy. Analyses were conducted to determine if the children whom coders could not rate on a particular item were different from the children whom they were able to rate on the item in terms of gender, other understanding of mind item ratings, positive affect, and engagement with the task. Only one significant difference was found. Forty-two-month olds whose false belief understanding could not be rated tended to have higher positive affect than their same age peers ($M = 4.5$ vs. 3.1, Mann-Whitney $U = 15.0$, $n_{\text{not rated}} = 4$, $n_{\text{rated}} = 43$, $p = .01$).

Gender related to understanding of mind composite percentages at the 66-month visit and to whether children passed both false belief tasks at the 42-month visit. Specifically, girls' composite scores assessed at the 66-month visit were significantly higher than boys' ($M = 97$ vs. 92, Mann-Whitney $U = 191.0$, $n_{\text{girls}} = 24$, $n_{\text{boys}} = 23$, $p = .05$), and twenty percent of girls, but no boys, passed both false belief tasks at 42 months of age, $\chi^2 (1, N = 48) = 4.74$, $p < .05$.

Mothers' Utterances

Descriptive statistics for mothers' utterances are listed in Table 2. About half were identified as relevant to the hiding game. The role for each relevant utterance was categorized as a statement, imperative, tag/yes or no question, or open-ended question. Percentages by role as well as the percentage that contained some form of nonverbal support are also listed in Table 2. Notably, approximately half of mothers' relevant utterances were questions, either tag/yes-no questions or open-ended questions, and mothers used relatively few imperatives during the hiding game. Although statements, imperatives, and tag questions have often been combined into a single variable and labeled directive utterances (e.g., Rogoff et al., 1984), in the current study the variables were kept separate given their pattern of correlations with one another (see Table 3). Specifically, tag/yes-no questions were significantly negatively correlated with both statements and imperatives, and statements and imperatives seemed unrelated.

Regarding content, mothers talked often about deception, less about false beliefs (see Table 2 for means), and rarely about knowledge access or belief-based emotions. Only 2, 5, and 6 mothers at the three annual visits, respectively, talked about knowledge access and only 11, 14, and 17 about belief-based emotions. Consequently, mothers' utterances regarding knowledge access were not analyzed further and those few utterances regarding belief-based

emotions were combined with the closely related false belief utterances; means and standard deviations are listed in Table 3.

Analyses were conducted to determine if the children whom coders could not rate on a particular scale were different from the children whom coders were able to rate on the scale in terms of the frequency of their mothers' utterances that focused on the corresponding content. Significant differences were: Mothers of children who were unable to be rated for their false belief understanding tended to talk less about false beliefs than mothers of children who could be rated at the first and second visits, ($M = 5$ vs. 15 & 6 vs. 15 , *Mann-Whitney* $U = 42.5$ & 42.0 , $n_{\text{not rated}}$ vs. $n_{\text{rated}} = 4$ vs. 43 & 5 vs. 43 , $p = .03$ for both). And, mothers of children who were unable to be rated for their understanding of belief-based emotions talked significantly less about belief-based emotions than mothers of children who were able to be rated at all three visits ($M = 0.0$ vs. 3.1 , 0.2 vs. 3.3 , & 0.3 vs. 2.9 ; *Mann-Whitney* $U = 38.5$, 63.5 , & 65.0 ; n_{rated} vs. $n_{\text{not rated}} = 12$ vs. 36 , 14 vs. 34 , & 24 vs. 32 ; $p < .01$ for all).

Relationships between Children's Understanding of Mind and Mothers' Utterances

Role of mothers' utterances—To see if mothers adjusted the role of their utterances to suit their child's understanding of mind, correlations between the role of the mother's utterance and the child's understanding of mind composite score were examined (see Table 4). At the 54-month visit, mothers who used relatively more tag/yes-no questions had children who showed higher understanding of mind. Given the lack of adjustments mothers seem to be making relative to their children's understanding of mind, an alternative question emerged. Did the mother have a particular conversational style that she consistently preferred regardless of her child's expertise or age? Further examination of the correlations between the roles of the utterance at each of the visits suggested that this hypothesis may have merit (see Table 3). Additionally, repeated measures analyses of variance indicated that mothers' use of statements, imperatives, tag/yes or no questions, open-ended questions, and nonverbal scaffolds did not vary significantly by visit (imperatives was marginal)— $F(2, 80) = 1.75, 3.02, 2.48, 2.94$, and 0.26 ; $p = .18, .05, .09, .15$, and $.77$; $\eta^2 = .04, .07, .06, .05$, and $.01$, respectively.

Content of mothers' utterances—To determine if mothers tailored the content of their utterances to their children's expertise, correlations between the children's ratings for understanding of knowledge access, deception, and false belief, and the corresponding content of mothers' utterances were examined. Mothers' utterances that focused on knowledge access or belief-based emotions were not examined because they occurred too rarely. Using Cohen's (1988) characterization of correlation coefficients of $.10$ as weak, $.30$ as moderate, and $.50$ as strong, 4 of 18 were at the weak-moderate border (see Table 5). Specifically, at the 42-month visit, mothers talked more about deception when their children demonstrated more sophisticated understanding of knowledge access ($r = .30$, $p = .063$); at both the 42- and 54-month visits, mothers talked more about false beliefs when their children demonstrated more sophisticated understanding of deception ($r = .31$ and $.29$, $p = .034$ and $.046$); and at the 66-month visit, mothers talked more about false belief when their children demonstrated a lack of false belief understanding ($r = -.30$, $p = .057$). Additionally,

the role and content of mothers' utterances did not predict understanding of mind scores at later visits.

Discussion

This longitudinal study produced nuanced descriptions of children's playful use of their emerging understanding of mind as they engaged in a shared hiding game with their mothers. Consistent with prior research (Wellman et al., 2001), children's overall understanding of mind increased with age in both the playful hiding game and in false belief tasks. More interesting, we found that various aspects of the children's understanding of mind during the hiding game developed sequentially. Moreover, when we looked at children's understanding of mind in finer detail, slight adjustments in mothers' scaffolding came to light.

The idea that children's understanding of mind would follow a predictable pattern of development is not new. Previous literature convincingly suggests that children have an understanding of desires that precedes their understanding of beliefs (Bartsch & Wellman, 1995; Gopnik & Slaughter, 1991; Wellman & Liu, 2004). In a series of scalable experimental tasks, Wellman and Liu (2004) extended this developmental progression. Children understand that individuals can hold different desires before different beliefs. An understanding of beliefs precedes an understanding of knowledge access which precedes an understanding of false beliefs. In the current study our goal was to extend the literature by focusing not on experimenter-led tasks but on an alternative context, a playful social interaction. Our observations of children during a hiding game with their mothers provided detailed evidence of the progressive development of an understanding of mind. As children played a trick on the experimenter, they expressed an understanding of knowledge access before an understanding of deception and false beliefs, and expressed an understanding of deception before an understanding of false beliefs.

Children's abilities to use their understanding of knowledge access increased and became more fine-tuned as they progressed through the preschool years. All children, even at 42-months of age, seemed to have some, albeit often immature, ideas about how an individual gains access to information. Forty-two month old children often displayed their knowledge access understanding by whispering or covering their mouth to quiet their giggles in order to conceal their trickery, which is somewhat surprising given past research that suggests 3-year-olds often have difficulty identifying the sources of their knowledge (O'Neill & Gopnik, 1991). By 54-months, children were even more proficient users of their understanding of knowledge access, often reminding their mothers to be quiet so the experimenter would not know their secret (see also O'Neill & Gopnik, 1991; Wellman & Liu, 2004).

As in other accounts of children's abilities to play hiding games (Peskin & Ardino, 2003), most children in the current study were not savvy deceivers at 42 months of age. Initially, most children tried to hide the toys by returning them to their original locations or by using fallible hiding strategies such as hiding a toy in an uncovered box. Typically, mothers intervened by suggesting alternate hiding locations or reminding the children of critical

strategic moves (e.g., shutting the lid of the box). Over time, the child's use of deception improved markedly, and by 66 months of age, almost all children skillfully hid the toys with few if any contributions from their mothers and confidently planned what they should do when the experimenter returned.

Children's expression of their false belief understanding showed the most dramatic shift over the preschool years. Nearly two-thirds of the children at 42 months of age displayed essentially no understanding of false beliefs. When mothers questioned where the experimenter might look for her toys when she returned, these children all persistently answered with reality-based answers even if the mother attempted to talk through the steps of the deception or repeat and rephrase her questions; see Figure 1 (top) for an example. By 54 months of age, about a third of the children received the midpoint score, vacillating between reality- and belief-based answers when responding to their mothers' questions regarding the experimenter's false belief. Such vacillation has been observed during false belief tasks as well (Amsterlaw & Wellman, 2006; Wellman et al., 2001). See Figure 1 (bottom) for an example of this interesting transitional phenomenon. Another third of the children showed sophisticated, adult-like understanding of false beliefs, always responding appropriately to their mothers' questions or skillfully using false hints to mislead the experimenter. By 66 months of age, most children received the highest rating for their expression of their false belief understanding during the hiding game, and no child received a rating lower than the midpoint.

Generally children readily and enthusiastically participated in the hiding game. Few of them needed coaxing or encouragement to gleefully join in the game, giggling and plotting about how to best trick the experimenter. During the first two visits, the more enthusiastic children showed greater understanding of mind than their few indifferent peers. Perhaps some amount of understanding was necessary to elicit the positive affect that often accompanies a well-played trick. The excitement and enthusiasm that permeated the vast majority of our observations suggest that the hiding game may be a particularly suitable context to explore active, emotionally engaging interactions during which children's understanding of others' minds develops (Hobson, 1993; Reddy, 2008).

All of the mothers in this study were willing and able to participate in an experimental manipulation on behalf of the experimenter. Their cooperation not only allowed us to observe the child with a knowledgeable intimate partner, it also let us to see how caregivers scaffold interactions. The mother clearly played a critical role. At times, she guided the child's participation, often serving as a role model quietly tiptoeing around the room or helping to find a good hiding place. Her curious questions to the child regarding the experimenter's knowledge of the toys' whereabouts and where she would look for them provided the backdrop for data gathered about the child's understanding of false beliefs.

Our findings suggest that over time, mothers may make subtle adjustment in the content of their utterances, keeping it one step ahead of the child's understanding of mind. At 42-months of age, when the child's behavior indicated mastery of knowledge access understanding, trends indicated that the mother spoke more frequently of deception, and when the child seemed to skillfully deceive and plot the trick, the mother focused her

utterances on false beliefs. When children were 54-months old, almost all acted as if they understood deception, leading the mothers to focus more on developing an understanding of false beliefs. And finally, when, at 66-months of age, the large majority of the children received the highest rating for understanding false beliefs during the hiding game, trends showed that even the slightest flaw in a child's use of this understanding often prompted the mother to discuss false beliefs, presumably to ensure the child fully understood false beliefs. However, findings were not as straightforward as we expected, and it is likely that mothers drew also on their vast store of their everyday experiences with the child as they decided how best to engage and guide the child in the hiding game.

Mothers did not seem to systematically vary the role of their utterances, supporting the conclusion that across the preschool years mothers consistently used a particular conversational style during the hiding game. Nevertheless, one interesting finding did emerge. At 54 months of age, a time when theory of mind development undergoes a shift, mothers' use of tag or yes/no questions seemed to be especially beneficial. Most of these questions led to a single answer and required the child only to agree or disagree. Thus, they might have provided valuable hints as children tried to use their nascent understanding of mind at a time when they might have been especially prone to suggestions (Ceci & Bruck, 1993).

Finally, in line with previous research (Charman, Ruffman, & Clements, 2002; Nelson et al., 2008; Walker, 2005), we found that girls outperformed boys on standard false belief tasks at 42 months of age and during the hiding game at the 66-month visit. It is noteworthy, however, the gender differences were not found at all ages and in both contexts. Thus an explanation of gender differences need to take into account not only enduring differences in skills such as language but also more fleeting variations in how boys and girls may be differentially affected by the demands of specific situations.

The current study has limitations regarding the children's ages, the format of the hiding game, and cultural relevance. Including younger children would likely yield a wider range of children's understanding of knowledge access, and older children might allow for the observation of mother-child dyads exploring belief-based emotions. Although the relatively brief hiding game within our laboratory did generate rich observations, the game likely did not fully capture all of the strategies mothers used to foster the development of the child's understanding of mind. And finally, when interpreting our results, it is important to note that this study is placed within a culture in which adults frequently engage children in child-focused play and conversations that often involve reciprocal dialogue; it is not likely that they would generalize to cultures in which learning through observation of adult activities predominates (Rogoff, 1990).

Despite these limitations, our hiding game may be a particularly revealing context for the study of variations in the development of social cognition, especially for children with autism spectrum disorders, who appear to have a theory of mind deficit when compared to their typically developing peers (Baron-Cohen et al., 1985; Yirmiya, Erel, Shaked, & Solomonica-Levi, 1998). Observing children with autism during parent-child interactions may be especially beneficial given the motivational and situational factors that make

experimenter-led theory of mind tasks particularly difficult and error prone in this group of children (Hutchins et al., 2008; Tager-Flusberg, 1999). Pilot data gathered from eight 64-month old verbal children with autism (Nelson, Adamson, & Bakeman, 2010) provide intriguing hints about how autism may affect the pattern and process of the development of understanding of mind. Only four children followed the predicted pattern of development suggesting that the developmental progression of understanding of mind for children with autism may not be as uniform as it is in typically developing children. Additionally, the children with autism showed slightly less positive affect during the hiding game compared to verbal mental age-matched typically developing peers, $M (SD) = 2.8 (0.89)$ and $3.3 (0.81)$, $\eta^2 = .07$, $p = .12$; however, their positive affect tended to predict understanding of mind, $r = .61$, $p = .10$, lending support to views that affective, interpersonal engagement may play an especially crucial role in the early emergence of social understanding (Hobson, 1993; Reddy, 2008).

In conclusion, understanding of mind is a multifaceted construct, and the study of its development benefits from complementary methods of study. In the current study, a playful hiding game provided a revealing context in which to observe children's understanding of mind while engaging in social interaction with their mothers. Children's understanding of mind not only increased with age, but also developed sequentially through the preschool years.

Acknowledgments

The research was funded by the National Institutes of Health, NICHD (R01-HD35612). The authors would like to thank Pamela K. Rutherford, Janis E. Sayre, Kimberly McMillan, and Deborah F. Deckner for their numerous contributions to this project. Thank you to Amy Lasher and K. Ramsey Simmons for coding the corpus. Preliminary data from this paper were presented as part of a doctoral dissertation to Georgia State University by the first author and were presented at the annual meeting of the Association for Psychological Science, San Francisco, CA, May 2009. Thank you to Christopher Henrich and Rebecca Williamson for their thoughtful critiques as members of the dissertation committee.

References

- Adamson, L.B. Communication development during infancy. Brown and Benchmark; Madison, WI: 1995.
- Adamson, L.B.; Bakeman, R. Transcribing maternal and child utterances. Georgia State University, Department of psychology; Atlanta: 1999. Tech. Rep. No. 10
- Adamson, L.B.; Bakeman, R. Communication play protocol—follow up. Georgia State University, Department of Psychology; Atlanta: 2000. Tech. Rep. No. 8b
- Adamson L.B., Bakeman R., Deckner D.F. The development of symbol-infused joint engagement. *Child Development*. 2004; 75:171–1187.
- Amsterlaw J, Wellman H.M. Theories of mind in transition: A microgenetic study of the development of false belief understanding. *Journal of Cognition and Development*. 2006; 7:139–172.
- Bakeman, R.; Gottman, J.M. *Observing interaction An introduction to sequential analysis*. 2nd ed.. Cambridge University Press; New York, NY: 1997.
- Bartsch, K.; Wellman, H.M. *Children talk about the mind*. Oxford University Press; New York, NY: 1995.
- Baron-Cohen S, Leslie A.M., Frith U. Does the autistic child have a “theory of mind”? *Cognition*. 1985; 21:37–46. [PubMed: 2934210]
- Bruner, J. *Child's talk: Learning to use language*. Norton; New York: 1983.

- Carpendale JI, Lewis C. Constructing an understanding of mind: The development of children's social understanding within social interactions. *Behavioral & Brain Sciences*. 2004; 27:79–151. [PubMed: 15481944]
- Ceci SJ, Bruck M. Suggestibility of the child witness: A historical review and synthesis. *Psychological Bulletin*. 1993; 113:403–439. [PubMed: 8316609]
- Charman T, Baron-Cohen S, Swettenham J, Baird G, Cox A, Drew A. Testing joint attention, imitation, and play as infancy precursors to language and theory of mind. *Cognitive Development*. 2000; 15:481–498.
- Charman T, Ruffman T, Clements W. Is there a gender difference in false belief development? *Social Development*. 2002; 11:1–10.
- Cohen J. Coefficient of agreement for nominal scales. *Educational and Psychological Measurement*. 1960; 20:37–46.
- Cohen J. Weighted kappa: Nominal scale agreement with provision for scaled disagreement or partial credit. *Psychological Bulletin*. 1968; 70:213–220. [PubMed: 19673146]
- Cohen, J. *Statistical power analysis for the behavioral sciences*. 2nd ed.. Lawrence Erlbaum Associates; Hillsdale, NJ: 1988.
- Doherty, MJ. *Theory of mind: How children understand others' thoughts and feelings*. Psychology Press; New York, NY: 2009.
- Gopnik A, Slaughter V. Young children's understanding of changes in their mental states. *Child Development*. 1991; 62:98–110.
- Hadwin J, Perner J. Pleased and surprised: Children's cognitive theory of emotion. *British Journal of Developmental Psychology*. 1991; 9:215–234.
- Hala S, Chandler M. The role of strategic planning in accessing false-belief understanding. *Child Development*. 1996; 67:2948–2966. [PubMed: 9071767]
- Hobson, RP. *Autism and the development of mind*. Lawrence Erlbaum Associates; Hillsdale, NJ: 1993.
- Hutchins TL, Bonazinga LA, Prelock PA, Taylor RS. Beyond false beliefs: The development and psychometric evaluation of the perceptions of children's theory of mind measure-experimental version (PCToMM-E). *Journal of Autism and Developmental Disorders*. 2008; 38:143–155. [PubMed: 17410414]
- Leekam SR, Perner J. Does the autistic child have a metarepresentational deficit? *Cognition*. 1991; 40:203–218. [PubMed: 1786675]
- McArthur D, Adamson LB, Deckner DF. As stories become more familiar: Mother-child conversations during shared reading. *Merrill-Palmer Quarterly*. 2005; 51:389–411.
- Meins E, Fernyhough C, Wainwright R, Das Gupta M, Fradley E, Tuckey M. Maternal mind-mindedness and attachment security as predictors of theory of mind understanding. *Child Development*. 2002; 73:1715–1726. [PubMed: 12487489]
- Nelson, PB.; Adamson, LB.; Bakeman, R. Preschoolers' understanding of mind: the role of affect and language for children with autism and typically developing children. Poster presentation at the annual Gatlinburg Conference on Research and Theory in Intellectual and Developmental Disabilities; Annapolis, MD. Mar. 2010
- Nelson PB, Adamson LB, Bakeman R. Toddlers' joint engagement experience facilitates preschoolers' acquisition of theory of mind. *Developmental Science*. 2008; 11:847–852. [PubMed: 19046153]
- O'Neill DK, Gopnik A. Young children's ability to identify the sources of their beliefs. *Developmental Psychology*. 1991; 27:390–397.
- Ontai LL, Thompson RA. Attachment, parent-child discourse and theory-of-mind development. *Social Development*. 2008; 17:47–60.
- Perner J, Frith U, Leslie AM, Leekam SR. Exploration of the autistic child's theory of mind: Knowledge, belief, and communication. *Child Development*. 1989; 60:689–700.
- Peskin J, Ardino V. Representing the mental world in children's social behavior: Playing hide-and-seek and keeping a secret. *Social Development*. 2003; 12:496–511.
- Peterson CC, Siegal M. Representing inner worlds: theory of mind in autistic, deaf, and normal hearing children. *Psychological Science*. 1999; 10:126–129.

- Randell AC, Peterson CC. Affective qualities of sibling disputes, mothers' conflict attitudes, and children's theory of mind development. *Social Development*. 2009; 18:857–874.
- Reddy, V. *How infants know minds*. Harvard University Press; Cambridge, MA: 2008.
- Robinson BF, Bakeman R. ComKappa: A Windows 95 program for calculating kappa and related statistics. *Behavior Research Methods, Instruments, and Computers*. 1998; 30:731–732.
- Rogoff, B. *Apprenticeship in thinking: Cognitive development in social context*. Oxford University Press; New York, NY: 1990.
- Rogoff B, Ellis S, Gardner W. Adjustment of adult-child instruction according to child's age and task. *Developmental Psychology*. 1984; 20:193–199.
- Ruffman T, Keenan TR. The belief-based emotion of surprise: The case for a lag in understanding relative to false belief. *Developmental Psychology*. 1996; 32:40–49.
- Ruffman T, Slade L, Crowe E. The relation between children's and mothers' mental state language and theory-of-mind understanding. *Child Development*. 2002; 73:734–751. [PubMed: 12038548]
- Symons DK, Fossum KM, Collins TBK. A longitudinal study of belief and desire state discourse during mother-child play and later false belief understanding. *Social Development*. 2006; 15:676–691.
- Szarkowicz DL. Young children's false belief understanding during play. *The Journal of Genetic Psychology*. 1999; 160:243–254.
- Tager-Flusberg, H. The challenge of studying language development in children with autism. In: Menn, L.; Bernstein Ratner, N., editors. *Methods for studying language production*. Lawrence Erlbaum; Mahwah, NJ: 1999. p. 313–331.
- Tager-Flusberg, H.; Baron-Cohen, S.; Cohen, D. Introduction to the debate. In: Baron-Cohen, S.; Tager-Flusberg, H.; Cohen, DJ., editors. *Understanding other minds: Perspectives form autism*. Oxford University Press; New York: 1993. p. 3–9.
- Vygotsky, L. *Mind in society*. Cole, M.; John-Steiner, V.; Scribner, S.; Souberman, E., editors. Harvard University Press; Cambridge, MA: 1978.
- Walker S. Gender differences in the relationship between young children's peer-related social competence and individual differences in theory of mind. *The Journal of Genetic Psychology*. 2005; 166:297–312. [PubMed: 16173673]
- Welch-Ross MK. Mother-child participation in conversation about the past: Relationships to preschoolers' theory of mind. *Developmental Psychology*. 1997; 33:618–629. [PubMed: 9232377]
- Wellman, HM. *The child's theory of mind*. MIT Press; Cambridge, MA: 1990.
- Wellman HM, Cross D, Watson J. Meta-Analysis of theory-of-mind development: The truth about false belief. *Child Development*. 2001; 72:655–684. [PubMed: 11405571]
- Wellman HM, Liu D. Scaling of theory-of-mind tasks. *Child Development*. 2004; 75:523–541. [PubMed: 15056204]
- Wimmer H, Hogrefe GJ, Perner J. Children's understanding of informational access as source of knowledge. *Child Development*. 1988; 59:386–396.
- Wimmer H, Perner J. Beliefs about beliefs: Representation and constraining function of wrong beliefs in young children's understanding of deception. *Cognition*. 1983; 13:103–128. [PubMed: 6681741]
- Yirmiya N, Erel O, Shaked M, Solomonica-Levi D. Meta-analyses comparing theory of mind abilities of individuals with autism, individuals with mental retardation, and normally developing individuals. *Psychological Bulletin*. 1998; 124:283–307. [PubMed: 9849110]

Conversation between a 42-month-old and his mother

M: Where d'you think she'll look for the doll?
C: In here {point}. [child points to doll's current location]
M: You think so?
M: You don't think she'll look (in the) in the box [experimenter left doll in the box]?
C: No.
C: Um the clock is in there.
M: I know.
M: But d'you think she'll expect to find the doll in there?
M: 'Cause that's where she put the doll.
M: Right?
C: Yeah.
M: And we moved it huh?
M: Where do you think she'll look for the doll?
C: In here {points}. [child points to cabinet, the doll's current location]
M: You think so?
C: Yeah.
M: Where do you think she'll look for the turtle?
C: Um where did we put it?
C: Behind there {point}. [child points to turtle's actual location]
M: We did put him behind there.
M: Do you think she'll know he's behind there?
C: Yeah.

Conversation between a 54-month-old and his mother

M: Where do you think she's gonna expect to find the snowman?
C: {points}. [points to snowman's actual location]
M: She's gonna expect that?
M: Where'd she put it?
C: {points}. [points to where the experimenter left the snowman]
M: So don't you think she'll think it'll be over there still {point}?
C: {Nods}.
M: Where is she gonna think the alligator is?
C: {Points}. [points to where the experimenter left the alligator]
M: Where is she gonna think the ball is?
C: {Points}. [points to actual location but then giggles, presumably realizing his mistake].

Figure 1.
Transcript of two conversations

Table 1

Children's Understanding

Variable	42-month visit		54-month visit		66-month visit				
	N	M	SD	N	M	SD	N	M	SD
Knowledge access	40	3.9	0.87	47	4.5	0.93	43	4.9	0.35
Deception	47	3.1	0.89	48	4.2	0.94	47	4.8	0.52
False belief	43	2.1	1.06	43	3.7	1.14	43	4.6	0.67
Composite (%)	47	60	16	48	83	17	47	94	08
Positive affect	47	3.2	0.87	48	3.4	0.81	47	3.4	0.71
Engagement	47	4.1	0.96	48	4.6	0.82	47	4.6	0.69

Note. Scores are means; all but the composite percentage are means of 1–5 ratings. N varies by variable due to the *not observed* code.

Table 2

Mothers' Utterances

Variable	42-month visit		54-month visit		66-month visit	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Number of utterances	100	22	94	21	87	24
% Relevant	54	16	55	17	50	17
Role						
% Statements	32	11	34	11	36	14
% Imperatives	16	10	14	09	15	09
% Tag or yes/no questions	32	11	28	10	26	11
% Open-ended questions	20	09	24	11	23	10
% Nonverbal scaffolds	24	11	22	12	23	13
Content						
Deception	39.1	14.8	36.2	15.2	28.8	11.5
False belief	14.4	11.9	14.3	8.8	12.4	7.88

Note. *N* = 47, 48, and 47 for the three annual visits, respectively. Scores are either mean frequencies or mean percents. Role percents and content frequencies are for relevant utterances.

Table 3

Correlations Between Mothers' Utterance Roles

Visit	Utterance role	1.	2.	3.	4.
42-month	1. Statement	—			
	2. Imperative	-.07	—		
	3. Tag question	-.45**	-.61**	—	
	4. Open question	-.55**	-.30*	-.01	—
	5. Nonverbal scaffold	0.01	.54**	-.35*	-.20
54-month	1. Statement	—			
	2. Imperative	-.12	—		
	3. Tag question	-.46**	-.41**	—	
	4. Open question	-.51**	-.35*	-.13	—
	5. Nonverbal scaffold	0.09	0.01	0.06	-.18
66-month	1. Statement	—			
	2. Imperative	-.21	—		
	3. Tag question	-.59**	-.30*	—	
	4. Open question	-.50**	-.33*	-.00	—
	5. Nonverbal scaffold	-.09	0.24	-.09	-.01

* $p < .05$

** $p < .01$

Table 4

Correlations Between Mothers' Utterance Roles and Children's Understanding of Mind Composite Scores

Utterance roles	42-mo. visit	54-mo. visit	66-mo. visit
Statement	.18	-.03	.24
Imperative	-.09	-.23	.03
Tag/yes or no question	-.03	.36*	-.19
Open-ended question	-.23	-.05	-.18
Nonverbal scaffold	.09	-.05	-.19

Note. $N = 47, 48,$ and 47 for the 42-, 54-, and 66- month visits, respectively. Correlations are Pearson product-moment.

*
 $p < .05$

Table 5

Correlation Between Mothers' Utterance Content and Children's Understanding

Visit	Child's understanding	Mothers' content	
		Deception	False Belief
42-months	Knowledge access	.30	.26
	Deception	.22	.31*
	False belief	.12	-.13
54-month	Knowledge access	.16	.13
	Deception	.08	.29*
	False belief	.14	.14
66-month	Knowledge access	-.10	.04
	Deception	.05	.08
	False belief	-.10	-.30

Note. $N = 44, 43$, and 45 for the 42-, 54-, and 66- month visits, respectively. Correlations are Spearman rank.

* $p < .05$