

## Maternal Mind-Mindedness and Attachment Security as Predictors of Theory of Mind Understanding

*Elizabeth Meins, Charles Fernyhough, Rachel Wainwright, Mani Das Gupta, Emma Fradley, and Michelle Tuckey*

This study investigated relations between social interaction during infancy and children's subsequent theory of mind (ToM). Infant–mother pairs ( $N = 57$ ) were observed in a free-play context at 6 months. Interactions were coded for (a) mothers' use of mental state language that commented appropriately on the infants' mental states, and (b) mothers' use of mental state language that did not appropriately reflect their infants' minds. A third variable was (c) security of attachment, which was assessed using the Strange Situation procedure at 12 months. Performance on a battery of ToM tasks at 45 and 48 months was positively correlated with (a), but was not related to (b) or (c). A regression analysis showed that mothers' use of appropriate mental state comments independently predicted overall ToM performance, accounting for 11% of the variance. Children's verbal ability was the only other independent predictor of ToM performance, accounting for 16% of the variance. These findings represent the earliest known social predictor of individual differences in ToM.

### INTRODUCTION

It is now more than a decade since researchers first turned their attention to social influences on the development of children's theory of mind (ToM). Since Dunn and colleagues (Dunn, Brown, Slomkowski, Tesla, & Youngblade, 1991) published their initial findings relating family environment to children's ToM abilities, there has been a steadily growing body of evidence suggesting that specific features of the early social environment are associated with precocity in children's understanding of mind. In their landmark study, Dunn et al. (1991) reported a relation between certain types of family interactions and children's subsequent ToM performance. They found that children were more likely to succeed on ToM tasks if their families had previously shown a tendency to discuss feelings and use causal state language, and if their mothers frequently attempted to control the behavior of older siblings. Subsequently, Perner, Ruffman, and Leekam (1994) reported that the mere presence of siblings had a facilitatory effect on ToM performance, although a re-analysis of these data suggested that this was true only for the presence of older siblings (Ruffman, Perner, Naito, Parkin, & Clements, 1998). Indeed, contact with older children and adults beyond the nuclear family appears to have a similar effect in aiding children's understanding of mind (Lewis, Freeman, Kyriakidou, Maridaki-Kassotaki, & Berridge, 1996). Recently, relations between global social factors and ToM performance have been reported. Children from families of higher socioeconomic status performed better on a range of ToM tasks than did peers from

more disadvantaged backgrounds (Cole & Mitchell, 1998, 2000; Cutting & Dunn, 1999; Holmes, Black, & Miller, 1996), and mothers' educational attainment has been found to correlate positively with their children's ToM performance (Cutting & Dunn, 1999; Meins & Fernyhough, 1999). Despite this growing body of evidence, researchers have been somewhat cautious about making strong arguments for a causal role for any of these social factors in ToM development.

Such caution appears justified, because the mechanisms through which children's social environment might influence their ToM are, as yet, poorly understood. Dunn (1994) argued that the reason why certain types of social interaction (e.g., psychological discourse, sibling conflict management, joint play, shared jokes, and moral reasoning) related to ToM performance was because they provide contexts in which children are confronted with conflicting views on the world. In turn, such conflicts in perspective facilitate children's developing understanding that reality may be represented and misrepresented. Fernyhough (1996) presented a broadly Vygotskian account of how the internalization of dialog relating to perspectival conflict might underlie individual differences in ToM performance. In a different vein, Lewis et al. (1996) discussed an "apprenticeship" model of ToM development, whereby children's interactions with older kin provide them with informal tutoring about the mind. Although these approaches make intuitive sense, they have thus far been unsuccessful in specifying precise

mechanisms by which exposure to mental state language and perspectival conflict might lead to children being better able to understand the mental states of others.

One problem for such accounts has been the difficulty of establishing the direction of causation in these apparent environmental effects on ToM. Among the reasons for this difficulty is the fact that even longitudinal studies (e.g., Dunn et al., 1991) have assessed social interaction only during the months immediately preceding the ToM assessments. This is problematic because, at such an age, children have already acquired a considerable vocabulary of mental and emotional state words, and thus may themselves be the driving force behind conversations using psychological language. For example, Bretherton, McNew, and Beeghly-Smith (1981) reported that some children begin to use emotion words as young as 18 months of age; and by 28 months, children are capable of using a wide repertoire of psychological state language to comment on their own and other people's past, present, and future behavior (Bretherton & Beeghly, 1982). Consequently, the observed link between certain types of family environment or interaction and precocity in children's ToM performance may simply reflect children's own ability to use mental state language and engage others in psychological discourse.

To make stronger claims about the causal influence of social-interactive factors on ToM development, it is necessary to find evidence that supports a relation between ToM performance and individual differences in some aspect of social interaction present before children have begun to acquire mental state language. One such factor that has been found to relate to later ToM performance is infant-mother attachment security. Meins, Fernyhough, Russell, and Clark-Carter (1998) reported that children who had been securely attached to their mothers in infancy performed better than did their insecure counterparts on the unexpected transfer ToM task (Wimmer & Perner, 1983) at age 4. Such long-term longitudinal findings allow one to claim with greater confidence that this aspect of children's social interactions facilitates their understanding of mind independently of their own early mentalizing abilities.

However, there are still problems in making causal links between attachment security and children's later ToM performance, because it is not immediately obvious why a behaviorally based assessment of infant-mother attachment should be related to children's ToM performance 3 years later. Although attachment relationships ultimately become representational in the form of internal working models, Bowlby (1980) argued that these models are not stable

or well established until 4 or 5 years of age. Consequently, no arguments for a direct link between infantile attachment security and ToM performance have been proposed. It may be that the observed security-related differences in ToM can be explained in terms of the other social factors found to influence children's understanding of mind. For example, it has been shown that, compared with their insecure-group counterparts, mothers of securely attached children are more sensitive tutors (e.g., continually using feedback from their child's performance to pitch instructions at an appropriate level) when collaborating with their children on a cognitive task (Meins, 1997a). Security-related differences in ToM performance could therefore be explained in terms of Lewis et al.'s (1996) apprenticeship model, with secure-group mothers proving to be more skilled and effective at providing their children with informal tutoring about the mind. Alternatively, secure-group mothers may be more likely to engage in the types of familial interaction shown by Dunn and colleagues (e.g., Dunn et al., 1991) to be related to superior ToM.

Meins et al. (1998) explained their findings somewhat differently, however, arguing that the reason for this link between attachment and ToM lies in security-related differences in mothers' mind-mindedness (Meins, 1997b); that is, the proclivity to treat one's infant as an individual with a mind, capable of intentional behavior. This explanation arose from Meins et al.'s (1998) finding that secure-group mothers were more likely than were their insecure-group counterparts to focus on their children's mentalistic attributes (rather than their physical appearance or behavioral tendencies) when given an open-ended invitation to describe their children. Moreover, children whose mothers had described them with reference to their mentalistic qualities showed higher ToM performance. However, as Meins et al. acknowledged, their study could not establish whether individual differences in maternal mind-mindedness lay behind security-related differences in children's ToM performance, because the mind-mindedness data were not collected until the children were 3 years of age. Thus, although they could give principled reasons why mind-mindedness should predate the formation of the attachment relationship, Meins et al.'s study could not test this hypothesis.

Subsequently, Meins, Fernyhough, Fradley, and Tuckey (2001) established that maternal mind-mindedness could be observed in infant-mother interactions during the first year of life. Mothers were classified as demonstrating mind-mindedness if they appropriately interpreted their infants' behavior with verbal reference to its putative attendant mental states,

such as thoughts, desires, intentions, and memories. This index of mothers' mind-minded comments turned out to be a better predictor of attachment security than did maternal sensitivity, which has traditionally been regarded to be the best indicator of subsequent attachment (see, e.g., Ainsworth, Bell, & Stayton, 1971, 1974). As well as replicating Meins et al.'s (1998) finding of greater mind-mindedness among secure-group mothers, Meins et al. (2001) provided support for the assumption that individual differences in maternal mind-mindedness predate the formation of the attachment relationship. This study also saw a refinement of the definition of maternal mind-mindedness. Rather than focusing on the mother's general proclivity to treat their infants as individuals with minds, Meins et al. (2001) argued that mind-mindedness at 6 months should be defined in terms of the mother's explicit use of mental state language to comment appropriately on her infant's mind.

Meins et al.'s (2001) finding of a predictive link between maternal mind-mindedness and security of attachment is relevant to the issue of ToM development for a number of reasons. First, it may help to explain security-related differences in ToM development, because early maternal mind-mindedness indexes a mother's capacity to represent appropriately the mental states of her infant, and thus "communicate understanding of the child's intentional stance" (Fonagy & Target, 1997, p. 679). This representational component is also clearly an essential component of ToM, which requires children to represent the mental states of themselves and others. Thus, a focus on this representational component of the mother's activity would make it possible to avoid the paradox, noted above, of trying to explain individual differences in ToM in terms of purely behavioral measures of attachment security. Security of attachment may therefore not predict children's ToM independently of maternal mind-mindedness. Second, Meins et al.'s (2001) findings highlight the need to distinguish between general exposure to psychological state language and exposure to comments that are appropriate references to the infant's current mental state. If general exposure facilitates ToM, then one would predict that higher maternal use of all types of psychological language would relate to better performance on ToM tasks. Alternatively, it may be that only specific types of psychological state language relate to later ToM performance. For example, by commenting appropriately on their infants' ongoing mental states and processes, mothers are providing their infants with a representational reference (the linguistic comment) for their current experience. One could argue that this contingency and temporal contiguity between infants' behav-

ior and their mothers' mind-related comments would make the connection between behavior and its attendant mental states more transparent, allowing infants to integrate information on their behavior with this external linguistic perspective on their own mental states. According to this view, only exposure to mental state language that appropriately reflects the infant's mental states would facilitate ToM development. Investigating the relative contributions to subsequent ToM performance of early exposure to these different types of mental state language was a major objective of the present study.

The general aim of the longitudinal study reported in this article was to investigate the relations between children's ToM development and two pre-existing social factors: early maternal mind-mindedness and infant-mother security of attachment. Our specific hypotheses were as follows: (a) mothers' use of mental state language to comment appropriately on their infants' minds at 6 months would be positively correlated with ToM performance at 45 and 48 months, (b) superior ToM performance at these ages would be observed in children who enjoyed a secure attachment relationship in infancy, and (c) mothers' use of appropriate mental state comments would be a better predictor of later ToM performance than would infant-mother attachment security. This study also set out to investigate how exposure to mental state language that does not appropriately reflect the infants' state of mind relates to children's subsequent ToM performance. Despite findings that general mental state language during the third and fourth years of life relates to superior ToM performance (e.g., Dunn et al., 1991), we hypothesized (d) that any such effect would be weaker than the effect for appropriate mental state comments. Thus, our final aim was to investigate the relative contributions of early exposure to these different types of mental state language to children's subsequent ToM.

## METHOD

### Participants

Participants were 57 children (28 girls, 29 boys) who were a subset of an original sample of 71 children who had been taking part with their mothers in a longitudinal study (Meins et al., 2001) since their first year of life. Participants were recruited through local health centers and baby clinics, with 60% of mothers who were approached agreeing to take part (see Meins et al., 2001). The reduction in numbers between the original and present sample was due to 6 families moving away from the area, 5 mothers declining to

continue because they were too busy, and 3 families being impossible to contact. Of the remaining 57 children, 54 were White, and 3 were of mixed race (2 children had a White mother and a Black father, 1 child had a White mother and an Asian father). As part of the earlier study, measures of maternal sensitivity and mind-mindedness were obtained at 6 months ( $M = 25$ , range = 23–28 weeks) and infant–mother attachment security was assessed using the Strange Situation procedure at 12 months ( $M = 53$ , range = 52–56 weeks). Children were followed up at 45 months ( $M = 45.8$ , range = 45–47 months) and 48 months ( $M = 48.3$ , range = 48–53 months) when their performance on age-appropriate ToM tasks was assessed.

### Background Variables

*Maternal education.* Mothers' level of education was included as an independent variable to control for the possibility that maternal mind-mindedness may relate to the amount of time mothers have spent in the education system, and also because maternal educational level has been found to correlate positively with children's ToM performance (Cutting & Dunn, 1999; Meins & Fernyhough, 1999). Mothers were given a questionnaire in which they were asked to identify their highest educational qualification by choosing one of six categories. Each mother was awarded one of the following scores for educational level (North American equivalents to the British educational system are shown in parentheses): 0, no examinations; 1, CSEs (equivalent to high school up to age 16 for less academic students); 2, GCSEs or O-Levels (high school up to age 16 for more academic students); 3, A-Levels (high school up to age 18); 4, further qualification, not to degree level (e.g., nursing); 5, undergraduate degree; and 6, postgraduate qualification. Of the 57 mothers participating: 6 scored 0, 6 scored 1, 16 scored 2, 3 scored 3, 19 scored 4, 4 scored 5, and 3 scored 6.

*Number of older siblings.* Number of older siblings was included as an independent variable due to its reported relation with children's ToM performance (Lewis et al., 1996; Ruffman et al., 1998). Of the 57 participating children, 29 were first-born, 20 had one older sibling, 5 had two older siblings, 2 had three older siblings, and 1 child had four older siblings.

### Assessment at Age 6 Months

Mothers were videotaped interacting with their 6-month-old infants in a 20-min free play session at the university's developmental research laboratory.

Mothers were given no specific instructions on how to act during these sessions, other than being asked to play with their infants as they would do if they had a few spare minutes together at home. Mothers' behavior was coded for maternal mind-mindedness, and the play sessions were also coded for maternal sensitivity. This latter measure was included to control for the possibility that a more general measure of the quality of infant–mother interaction, rather than maternal mind-mindedness specifically, might predict children's subsequent ToM performance.

*Maternal mind-mindedness.* Every comment the mother made during the session was categorized. Following the criteria of Meins et al. (2001), a comment was defined as a discrete sound, single word, or sentence. For example, both of the following utterances would be scored as containing two comments: "Ball. Ball." and "That's a nice ball. Do you like the ball?" These maternal comments were then categorized according to whether they included mental state language. We defined mental state language using Meins et al.'s (2001) category of mind-related comments: (a) comments on mental states, such as knowledge, thoughts, desires, and interests (e.g., "You know what that is, it's a ball."; "I think that you think it's a drum."); (b) comments on mental processes (e.g., "Do you remember seeing a camel?"; "Are you thinking?"); (c) references to the level of emotional engagement (e.g., comments about being bored, self-conscious, or excited); (d) comments on attempts to manipulate people's beliefs (e.g., "You're joking."; "You're just teasing me."); (e) the mother "putting words into her infant's mouth" so that the mother's discourse took on the structure of a dialog between her infant and herself (e.g., "He says, 'I think I've got the hang of that now'."; "She says, 'I'm not interested in him, I've already got one'.").

Naturally, many of the comments made by mothers during the 20-min session did not contain mental state language. The coding scheme for mothers' comments included seven categories in addition to the category of explicit use of mental state language (these other categories were mother names object, mother describes object, mother imitates infant's vocalization, mother encourages infant to perform an action, mother gives positive feedback, mother directs attention, mother engages infant in standardized game routine). The videotapes were coded by a researcher who was blind to all other measures and to the study's hypotheses, and a randomly chosen fifth of the tapes was coded by a second blind researcher. Interrater agreement for assignment of maternal comments to the eight categories (the seven categories above and the mind-related comments category) was

$\kappa = .89$ . Because the focus of the present study concerned the links between maternal mental state language and children's ToM performance, data on the other seven categories of maternal comments are not reported here. (Note that scores for none of these other categories were related to children's ToM performance.)

Next, we determined whose mental states mothers were commenting on. The vast majority of mothers' mental state comments referred to their infants' states of mind, and mothers only rarely commented on the mental states of people other than their infants. Only 6 mothers referred to another person's mental state, with a total of 11 comments in this category. Due to their rarity, these comments were excluded, and the analyses focused exclusively on mothers' mental state language that referred to their infants' mental states and processes.

The category of mothers' use of mental state comments referring to their infants' minds was subdivided to investigate the relative contribution to children's subsequent ToM performance of mothers' use of (a) mental state comments that were appropriate reflections of the infant's mental state, and (b) mental state comments that did not appropriately reflect the infant's mind. Each mind-related comment was coded dichotomously as appropriate or inappropriate using Meins et al.'s (2001) criteria for "appropriate mind-related comments." A comment was classified as an appropriate mind-related comment if (a) the independent coder agreed with the mother's reading of her infant's psychological state (e.g., if a mother commented that her infant wanted a particular toy, it would be an appropriate comment if the coder concurred that the infant's behavior was consistent with such a desire); (b) the comment linked the infant's current activity with similar events in the past or future, for example, "Do you remember seeing a camel?" (while playing with a toy camel); (c) the comment served to clarify how to proceed if there was a lull in the interaction, for example, "Do you want to look at the posters?" (after the infant had been gazing around the room, not focused on any object or activity, for 5 s). Criteria for "inappropriate mind-related comments" were (a) the coder believed that the mother was misinterpreting her infant's psychological state (e.g., stating that the infant was bored with a toy when he/she was still actively engaged in playing with it); (b) the comment referred to a past or future event that had no obvious relation to the infant's current activity; (c) the mother asked what the infant wanted to do, or commented that the infant wanted or preferred a different object or activity, when the infant was already actively engaged in an activity or

was showing a clear preference for a particular object; (d) the referent of the mother's comment was not clear (e.g., saying "You like that" when the object or activity to which the comment referred was not obvious). The criteria for these two types of mind-related comments were exclusive and exhaustive. An independent, trained researcher, who was blind to all other measures and to the hypotheses of the study, coded mental state comments using the appropriate versus inappropriate criteria. A second trained researcher coded a randomly selected fifth of the infant-mother interactions. Interrater agreement was  $\kappa = .79$ .

To control for maternal verbosity, scores for appropriate and inappropriate mind-related comments were computed as proportions of the total number of comments produced during the 20-min session. One might argue that these scores should be calculated as proportions of the number of mind-related comments, rather than total number of comments. We chose the latter method of calculating scores to present a truer picture of the frequency with which mothers made appropriate and inappropriate mind-related comments throughout the testing session. For example, if scores had been calculated as a proportion of mind-related comments, proportional scores of 1 for appropriate and 0 for inappropriate mind-related comments would be awarded to a mother who made only one (appropriate) mind-related comment. We reasoned that this would not provide an accurate picture of such a mother's proclivity to engage in mind-minded discourse. That said, analyses using these alternative indices produced exactly the same pattern of results as those reported in the Results section.

The mean total number of comments produced during the session was 142.61 ( $SD = 41.45$ ), for total number of appropriate mind-related comments  $M = 13.83$  ( $SD = 9.15$ ), and for total number of inappropriate mind-related comments  $M = 2.07$  ( $SD = 3.13$ ). With respect to the mean proportional scores for the whole sample, for appropriate mind-related comments  $M = .10$  ( $SD = .06$ ), and for inappropriate mind-related comments  $M = .02$  ( $SD = .02$ ). High scores for appropriate mind-related comments are indicative of greater maternal mind-mindedness.

*Maternal sensitivity.* Ainsworth et al.'s (1971) 9-point scale was used to assess how sensitive mothers were when interacting with their infants. This scale gives a global rating of mothers' sensitivity to their infants' cues, rather than coding specific types of maternal behavior. Higher scores on this scale are indicative of more sensitive mothering. The videotaped play sessions were coded by a trained researcher, and a randomly chosen fifth of the tapes was coded by a second researcher. Both researchers were blind to all

other measures and to the study's hypotheses. Interrater agreement was  $\kappa = .75$ , with exact agreement for 79% of the observations.

#### Assessment of Attachment Security

Infant–mother attachment security was assessed using the Strange Situation procedure (Ainsworth & Wittig, 1969) when the children were 12 months of age. Of the 57 infants, 39 were classified as securely attached, with the remaining 18 falling into the three insecure categories (10 insecure–avoidant, 5 insecure–resistant, and 3 insecure–disorganized). With regard to the 14 children who were lost from the original sample, 10 were securely attached and the remainder were insecure–avoidant, suggesting that the balance of secure and insecure classifications among the lost participants was comparable with that in the sample as a whole. The Strange Situation tapes were coded by the first author, who has formal training in the Strange Situation coding procedure (Ainsworth, Blehar, Waters, & Wall, 1978), and a randomly chosen fifth of the tapes were coded for a second time by an independent trained rater. Interrater agreement was  $\kappa = .87$  using the ABCD categories, and  $\kappa = .85$  using a secure versus insecure distinction. The classification of the 1 child about whom the raters disagreed was resolved by discussion. Due to the low numbers of children in the separate insecure attachment categories, attachment security was treated as a dichotomous variable (secure/insecure) in the analyses.

#### Phase 1 Testing (Age 45 Months)

Children participated at home in two age-appropriate ToM tasks (appearance–reality and deceptive box), the presentation of which was counterbalanced.

*The appearance–reality task.* Children received a version of the task originally developed by Flavell, Flavell, and Green (1983). Children were given four trials, each using an object whose appearance was deceptive (a sponge that looked like a football, a torch that looked like a fish, a frog pencil sharpener, and a cat-shaped salt cellar). The experimenter (E) showed the object to the child, saying, “When you look at this with your eyes right now, what does it look like?” After the child answered, E demonstrated what the object really was. The child was then asked two test questions: (a) “What is this really and truly? and (b) “When you look at it with your eyes right now, does it look like a [football] or does it look like a [sponge]”? The order of presentation of the four objects, and that of the “look” versus “really and truly” questions, was fully randomized and counterbalanced. Children re-

ceived one mark if they answered both the reality and appearance questions correctly for each of the four objects, giving a score out of 4 for their overall performance on the appearance–reality task.

*The deceptive box task.* Children were given a version of the deceptive box task devised by Hogrefe, Wimmer, and Perner (1986). Each child was shown a tube of candies and asked what he or she thought was inside. The tube was then opened to show the child that it contained, not candies, but a pencil. The child was then asked, “Can you remember what’s inside here?” (memory control). A toy animal, Freddy the frog, was used as the naive other, and the child was asked, “What does Freddy think is in the candies tube?” This task was scored dichotomously as pass/fail.

#### Phase 2 Testing (Age 48 Months)

*The unexpected transfer task.* At age 48 months, children were tested at home on two versions of the unexpected transfer task (Wimmer & Perner, 1983) to assess their understanding of how beliefs determine behavior. The two versions used different toy animals and different colored boxes. In one story, participants were introduced to Charlie the Crocodile, and told that his favorite food was chocolate. A chocolate was placed into one of two small boxes—one red and the other blue. The child was told that Charlie was hiding his chocolate while he went for a swim. Charlie was removed from the scene, and a puppet, Cheeky Monkey, was introduced to the child. The experimenter announced that Cheeky Monkey was going to play a trick on Charlie. Cheeky Monkey then took the chocolate out of the box in which it had been hidden and placed it in the other box, closing both lids. The child was told that Charlie was about to return from his swim, and that he would want his chocolate. Two control questions were asked: “Where was the chocolate in the beginning?” (memory control), and “Where is the chocolate now?” (reality control). If a child answered either of these questions incorrectly, the story was briefly recapped and the two control questions repeated, but the child was not explicitly corrected. When correct answers had been given to both control questions, the test question was presented: “Where will Charlie look for his chocolate?” The second version of this task was identical to the first, except that in this instance a different animal hid a toy in either a silver or gold box. For each of the two versions, children received a score of 1 if they passed, or 0 if they failed, giving an overall score between 0 and 2.

*Receptive verbal intelligence.* Children's receptive verbal intelligence was assessed using the British Picture Vocabulary Scale II (BPVS II; Dunn, Dunn,

Whetton, & Burley, 1997) to control for the effects of verbal IQ on the other variables. The mean BPVS II score for the entire group was  $M = 110.72$  ( $SD = 12.02$ ).

### Composite ToM Measure

To provide a picture of children's overall ToM performance across the three tasks and the two testing ages, a composite ToM score was computed for each child. Previous studies using the same standard ToM tasks have found that performance across these tasks is highly correlated (e.g., Carlson & Moses, 2001; Hughes & Dunn, 1998; for studies employing similar composite measures, see Astington & Jenkins, 1999; Carlson & Moses, 2001; Cole & Mitchell, 2000; Cutting & Dunn, 1999; Dunn, Cutting, & Demetriou, 2000; Hughes & Dunn, 1998). To give equal weighting to each of the three tasks in our composite, scores for the individual tasks were scaled to give a maximum score of 2 for each task (cf. Hughes & Dunn, 1998). Scores for the appearance–reality task were divided by 2, and scores for the deceptive box were multiplied by 2. The maximum possible score for overall ToM performance was therefore 6. Composite scores ranged from 0 to 6, with a mean of 2.87 ( $SD = 1.86$ ). Skewness for the composite measure was .10 with an  $SE$  of .32,  $z = .31$ ,  $ns$ ; and kurtosis was  $-1.07$ ,  $z = 1.65$ ,  $ns$ , leading us to assume that scores on our composite measure were normally distributed.

With respect to the reliability of the composite measure, all interitem (appearance–reality, deceptive box, and unexpected transfer scores) and item–total correlations were positive, and all were significant ( $r$ s between .30 and .80,  $df = 55$ ), except for the correlation between appearance–reality and unexpected transfer task scores,  $r(55) = .13$ . Cronbach's  $\alpha$  for the composite measure was .50, which is a modest level of reliability (Nunnally, 1967). Although this value is below that recommended by Nunnally (1978), there are several reasons for accepting it for the purposes of the present study. First, there is some disagreement about the need for strict adherence to a critical value of Cronbach's  $\alpha$ , particularly when researchers are not making important decisions about the fates of individuals, and when complete homogeneity is not expected (Pedhazur & Schmelkin, 1991). Second, the reliability of our composite measure is in line with previous studies that have used similar composite ToM measures (Astington & Jenkins, 1999; Hughes & Dunn, 1998). Third, although the reliability of our measure is not as high as that reported in some studies (e.g., Cutting & Dunn, 1999), these studies have tended to use several versions of the same kind of task (e.g., false-belief prediction), in which higher reliability

would be expected. In contrast, our aim was to give a picture of ToM performance across a range of tasks, which are nevertheless thought to tap a common underlying cognitive capacity (e.g., Perner, 1991).

## RESULTS

### Pairwise Correlations between Variables

Table 1 shows the correlation matrix for the relations between all of the independent variables and children's overall ToM scores. Children's ToM performance was positively correlated with their BPVS II scores, maternal educational level, mothers' appropriate mind-related comments, and maternal sensitivity. Thus, children performed better on the battery of ToM tasks if they had higher verbal IQs, and had mothers who were more highly educated, more sensitive with them at 6 months, and who commented appropriately on their mental states and processes at 6 months. Overall ToM performance was not related to mothers' inappropriate mind-related comments, attachment security, or the number of older siblings in the family.

Attachment security was positively correlated with mothers' appropriate mind-related comments, and negatively correlated with mothers' inappropriate mind-related comments. Children were therefore more likely to be securely attached if their mothers commented appropriately on their mental states at 6 months, and refrained from using inappropriate mind-related comments. Maternal sensitivity was positively correlated with appropriate mind-related comments.

**Table 1** Correlation Matrix for Independent and Dependent Variables

	BPVS	Mat Ed	Sibs	App	Inapp	MS	Sec	ToM
BPVS								
Mat Ed	.55****							
Sibs	-.16	-.20						
App	-.01	.16	-.13					
Inapp	.05	.03	.04	-.08				
MS	.16	.27	-.05	.39**	-.05			
Sec	-.10	-.07	-.06	.42***	-.54****	.14		
ToM	.37**	.29*	-.13	.34**	-.15	.32*	.16	

Note: BPVS = children's British Picture Vocabulary Scale II scores; Mat Ed = mothers' highest educational level; Sibs = number of older siblings in the family; App = mothers' proportional scores for appropriate mind-related comments; Inapp = mothers' proportional scores for number of inappropriate mind-related comments; MS = maternal sensitivity; Sec = attachment security; ToM = children's composite theory of mind scores.

\* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .005$ ; \*\*\*\* $p < .001$ . All tests were two-tailed.

More sensitive mothers were thus more likely to comment appropriately on their infants' mental states and processes. These findings on the relations between early maternal mind-mindedness, maternal sensitivity, and attachment security replicate Meins et al.'s (2001) findings in this subset of the original sample. Finally, children's BPVS II scores were positively correlated with maternal educational level, with children of more highly educated mothers obtaining higher verbal IQ scores.

#### Predictors of Overall Theory of Mind Performance

To establish which variables were independent predictors of overall ToM performance, a forward regression analysis was performed. Seven factors were entered into the regression: BPVS II score, maternal educational level, number of older siblings, maternal sensitivity, inappropriate mind-related comments, appropriate mind-related comments, and attachment security. The regression analysis showed that children's BPVS II scores were the best predictor of overall ToM performance ( $R^2 = .16$ ,  $T = 3.29$ ,  $\beta = .41$ ,  $p < .005$ ), followed by appropriate mind-related comments ( $R^2 = .11$ ,  $T = 2.80$ ,  $\beta = .33$ ,  $p < .01$ ). None of the other independent variables were significant predictors of composite ToM scores. Thus, children's BPVS II scores and mothers' appropriate mind-related comments were the only independent predictors of overall ToM performance, with children of higher verbal IQ and those whose mothers more frequently used appropriate mind-related comments at 6 months attaining higher scores on the composite ToM index. Children's BPVS II scores and mothers' appropriate mind-related comments accounted for 16% and 11% of the variance in overall ToM performance, respectively.

## DISCUSSION

The results of the present longitudinal study provide broad support for our first hypothesis: that early maternal mind-mindedness, defined as the mother's proclivity to comment appropriately on her infant's mental states, predicts children's later ToM performance. Mothers' appropriate mind-related comments at 6 months accounted for 11% of the variance in children's composite ToM scores. The regression analysis showed that the only other independent predictor of ToM performance was children's BPVS II scores, accounting for 16% of the variance. This clear link between verbal IQ and ToM performance is in line with previous findings (e.g., Happé, 1995; Jenkins & Astington, 1996).

With respect to our second hypothesis, we found

no relation between attachment security and children's ToM performance. The regression analysis showed that attachment security was not a predictor of ToM performance, and composite ToM scores and attachment security were not significantly correlated. We therefore failed to replicate previous findings of a link between security of attachment in infancy and children's ToM at age 4 (Meins et al., 1998). The results of the regression analysis thus supported our third hypothesis in showing that early maternal mind-mindedness is a better predictor of subsequent ToM performance than is infant-mother attachment security.

Our fourth aim was to investigate whether early exposure to mental state language that does not appropriately reflect the infant's mind facilitates subsequent ToM performance. Our results showed that early exposure to this type of general psychological state language was not related to ToM performance. The regression results thus provide support for our fourth hypothesis, showing that early exposure to appropriate mind-related comments is a better predictor of subsequent ToM performance than is exposure to mental state language that does not appropriately reflect the infant's state of mind.

Finally, some mention should be made of the relations between ToM performance and the other independent variables. With respect to family size, we found no relation between number of older siblings and ToM performance. Our findings thus add to a growing number of studies (Carlson & Moses, 2001; Cole & Mitchell, 1998, 2000; Cutting & Dunn, 1999; Meins & Fernyhough, 1999) that have failed to replicate findings of a facilitatory effect of siblings on children's ToM abilities (e.g., Perner et al., 1994; Ruffman et al., 1998). In line with previous findings (Cutting & Dunn, 1999; Meins & Fernyhough, 1999), the results of the present study showed that mothers' educational attainment was related to children's ToM performance, with children of more highly educated mothers attaining higher scores on the composite ToM measure. However, the regression analysis showed that maternal educational attainment was not an independent predictor of children's ToM. Maternal sensitivity at 6 months correlated positively with children's composite ToM scores, but, once again, the regression analysis showed that this variable was not an independent predictor of overall ToM performance.

In summary, the results of this study showed children's ToM performance to be significantly predicted by their mothers' tendency to comment appropriately on their mental states at 6 months. This relation between early maternal mind-mindedness and later ToM was independent of children's verbal ability,



mothers' educational attainment, maternal sensitivity, and the number of older siblings in the family. Our data also show this relation to be independent of infant–mother attachment security. Finally, our findings suggest that only exposure to specific kinds of mental state language facilitates later ToM performance; namely, comments that are judged to be appropriate reflections of the infant's state of mind. Exposure to mental state language that is not matched to the infant's mind state was not found to correlate significantly with later ToM performance.

The findings of this study are therefore in line with a growing body of research that has demonstrated social influences on ToM development. With respect to their finding that children who had been securely attached in infancy went on to outperform their insecurely attached peers on a range of ToM tasks, Meins et al. (1998) suggested that one reason for this effect might be the greater proclivity of secure-group mothers to treat their children as individuals with minds. A later study (Meins et al., 2001) showed such individual differences in mind-mindedness to be present in the first year of life. The findings of the present study showed this measure of mind-mindedness to be a significant predictor of ToM performance more than 3 years later. However, contrary to previous findings, this study found no link between infantile attachment security and children's understanding of mind. Our results, therefore, support Meins et al.'s (1998) conclusion that the relation between attachment and ToM can be explained best in terms of individual differences in mothers' mind-mindedness.

Perhaps the most notable contribution of the present study is our identification of what is the earliest known social predictor of mentalizing development. Of particular importance is the fact that maternal mind-mindedness appears to have its effects independently of individual differences in children's own mentalizing abilities. As noted in the Introduction section, most previous longitudinal research in this area (e.g., Dunn et al., 1991) has only obtained measures of social environment and interaction at an age when children have already made considerable advances in mentalizing development, enabling them to talk competently about their own and other people's psychological states. In contrast, we found that children's ToM is predicted by maternal mind-mindedness at an age when children have not yet acquired any language, and are in the early stages of sensorimotor development. Moreover, the finding that neither maternal sensitivity nor infant–mother attachment security were independent predictors of children's subsequent ToM performance suggests that it is specifically early maternal mind-mindedness, rather than

the general quality of infant–mother interaction, that influences the development of a representational theory of mind.

We should, however, hold off from making too strong a causal claim for the influence of mind-mindedness until additional research is performed to investigate its temporal continuity. Although our findings suggest that mind-minded comments may begin to influence children's developing ToM from the earliest months of life, we would equally expect exposure to such language to continue to play a role in the preschool years. Indeed, it may turn out that the importance of mind-mindedness lies not in any direct influence in the first year of life, but in its persistence into the preschool years, at which point it may begin to play its part in instructing children about how mental states underlie behavior. If, however, such continuities prove difficult to document, then we will need to establish precisely when the sensitive periods for exposure to appropriate mental state language might occur. One thing that seems certain is that the expression of mind-mindedness will change as the child matures. It is also important to bear in mind that genetically transmitted factors such as temperament might potentially explain the observed relation between mind-mindedness and children's ToM performance, and future research should attempt to investigate this possibility.

Given our suggestion of an influence of mind-minded language in mentalizing development, it is clearly essential to consider the possible contributions of the mind-minded comments of individuals other than the mother, and of comments made by the mother to other individuals, particularly siblings. One of the strengths of the studies of Dunn and colleagues is their ability to take a view of the entire family context, as well as children's interactions with peers (e.g., Brown, Donelan-McCall, & Dunn, 1996). Such studies are required to establish whether, for example, a mother's mind-mindedness with one infant carries over to her interactions with her other children. One would imagine that exposure to comments that reflect the mental processes of other individuals will also be important in nurturing the young child's understanding of mind. As Fonagy and colleagues (e.g., Fonagy & Target, 1997) have argued, caregivers' general tendency to explain people's behavior with reference to their mental states (assessed by Fonagy's group from analysis of interview-derived recollections of attachment experiences) may be crucial in children's developing understanding of how beliefs and desires determine behavior. However, the study reported here was unable to test the importance of mothers' reflections on others' mental states, because mothers commented so rarely on the mental states of

people other than their infants. It is likely that our dyadic laboratory-based observation encouraged mothers to focus quite exclusively on their infants, rather than talk about their own mental states or those of absent others. We therefore acknowledge the need to investigate how mothers and other people use mind-minded discourse during daily caregiving activities and family routines in the home.

Despite these cautionary notes, it is possible to map out a developmental pathway to illustrate how early maternal mind-mindedness might influence children's later ToM development. Our specific proposal is as follows. We have shown that mothers routinely offer mentalistic comments on their infants' behavior even at 6 months of age. We suggest that exposure to such language from the earliest months of life provides children with an opportunity to integrate their own behavior with an external comment that makes reference to the mental states underlying that behavior. Such comments thus offer a scaffolding context within which infants can begin to make sense of their own behavior in terms of its underlying mental states. For example, one mother in the present study commented, "You recognize this, don't you?" when her child immediately started playing with a toy that he had at home. Another mother asked her child, "Are you thinking?" when she saw him sitting quietly, looking pensive. Repeated exposure to such comments about their activity (or lack of activity) with reference to their likely attendant mental states may ultimately help children to become aware of their own and other people's mental states and processes, and how they govern behavior. Indeed, some of the mind-minded comments observed in this study showed that mothers appear to expect their infants not only to understand what they are saying, but to respond with a clarification of precisely what they want or think. For example, after hearing her infant produce a particular vocalization, one mother said, "That means you want something. What do you want?" Such instances may provide a further spur to children's making sense of behavior in terms of mental states. Such a view is in line with Harris's (1996; Harris & Leevers, 2000) suggestion that the apparent links between conversational language and mentalizing development can best be explained in terms of the opportunities such language provides for integrating subjective information on one's own mental state with an external linguistic comment.

Finally, the findings of the current study have clear implications for previous studies that have shown a link between exposure to general mental state language and ToM (e.g., Dunn et al., 1991). Why did this study find no such link with general mental state lan-

guage, as indexed by our measure of inappropriate mind-related comments? One reason might lie in the age of the children participating in these different studies. Researchers such as Dunn et al. (1991) have focused their investigations on preschool-age children, whose mental states are arguably more transparent and readable than are those of 6-month-old infants. Indeed, young children are known to have problems in hiding their true feelings (e.g., Saarni, 1984). Consequently, mothers' comments on such children's mental states might be expected to be generally more accurate than would be the case with infants, and would thus be coded as appropriate mind-related comments according to the criteria described here. For example, without the ability accurately to read one's child's mental states, it would be impossible to produce the type of comment that Dunn et al. (1991) reported as relating to superior ToM performance (e.g., "She didn't know I had promised it to you."; "He thought it was his turn."). Rather than seeing our results as contradicting these earlier findings, we would instead suggest that our account is fully consistent with the work of Dunn and others relating to exposure to mental state language during the preschool years. Careful investigation of continuities and discontinuities in mind-mindedness and their relation with ToM would thus seem to be a priority for future research.

#### ACKNOWLEDGMENTS

This study was supported by two grants from Staffordshire University and a grant from the Economic and Social Research Council (R000222355) awarded to the first two authors. The authors thank the mothers and children for their continued enthusiasm and commitment to the project, and Bronia Hurst for assistance with coding. They also thank Robert Drewett for his statistical advice; and Sue Leekam, Ross Thompson, and three anonymous reviewers for their helpful comments on this article.

#### ADDRESSES AND AFFILIATIONS

Corresponding author: Elizabeth Meins, Department of Psychology, University of Durham, Science Laboratories, South Road, Durham DH1 3LE, U.K.; e-mail: elizabeth.meins@durham.ac.uk. Charles Fernyhough is also at the University of Durham; Rachel Wainwright, Mani Das Gupta, Emma Fradley, and Michelle Tuckey are at Staffordshire University, Stoke on Trent, U.K. At the time of this study, Elizabeth Meins and Charles Fernyhough were also at Staffordshire University.

## REFERENCES

- Ainsworth, M. D. S., Bell, S. M., & Stayton, D. J. (1971). Individual differences in Strange Situation behavior of one year olds. In H. R. Schaffer (Ed.), *The origins of human social relations* (pp. 17–52). New York: Academic Press.
- Ainsworth, M. D. S., Bell, S. M., & Stayton, D. J. (1974). Infant-mother attachment and social development: Socialisation as a product of reciprocal responsiveness to signals. In M. P. M. Richards (Ed.), *The introduction of the child into a social world* (pp. 99–135). London: Cambridge University Press.
- Ainsworth, M. D. S., Blehar, M. C., Waters, E., & Wall, S. (1978). *Patterns of attachment: A psychological study of the Strange Situation*. Hillsdale, NJ: Erlbaum.
- Ainsworth, M. D. S., & Wittig, B. A. (1969). Attachment and exploratory behavior of one year olds in a strange situation. In B. M. Foss (Ed.), *Determinants of infant behavior* (Vol. 4, pp. 113–136). New York: Barnes and Noble.
- Astington, J. W., & Jenkins, J. M. (1999). A longitudinal study of the relation between language and theory of mind development. *Developmental Psychology, 35*, 1311–1320.
- Bowlby, J. (1980). *Attachment and loss: Vol. 3. Loss: Sadness and depression*. New York: Basic Books.
- Bretherton, I., & Beeghly, M. (1982). Talking about internal states: The acquisition of an explicit theory of mind. *Developmental Psychology, 18*, 906–921.
- Bretherton, I., McNew, S., & Beeghly-Smith, M. (1981). Early person knowledge as expressed in gestural and verbal communication: When do infants acquire a “theory of mind”? In M. Lamb & L. Sherrod (Eds.), *Social cognition in infancy* (pp. 333–373). Hillsdale, NJ: Erlbaum.
- Brown, J. R., Donelan-McCall, N., & Dunn, J. (1996). Why talk about mental states? The significance of children’s conversations with friends, siblings, and mothers. *Child Development, 67*, 836–849.
- Carlson, S. M., & Moses, L. J. (2001). Individual differences in inhibitory control and children’s theory of mind. *Child Development, 72*, 1032–1053.
- Cole, K., & Mitchell, P. (1998). Family background in relation to deceptive ability and understanding of the mind. *Social Development, 7*, 181–197.
- Cole, K., & Mitchell, P. (2000). Siblings in the development of executive control and a theory of mind. *British Journal of Developmental Psychology, 18*, 279–295.
- Cutting, A. L., & Dunn, J. (1999). Theory of mind, emotion understanding, language, and family background: Individual differences and interrelations. *Child Development, 70*, 853–865.
- Dunn, J. (1994). Changing minds and changing relationships. In C. Lewis & P. Mitchell (Eds.), *Children’s early understanding of mind: Origins and development* (pp. 297–310). Hove, U.K.: Erlbaum.
- Dunn, J., Brown, J., Slomkowski, C., Tesla, C., & Youngblade, L. M. (1991). Young children’s understanding of other people’s feelings and beliefs: Individual differences and their antecedents. *Child Development, 62*, 1352–1366.
- Dunn, J., Cutting, A. L., & Demetriou, H. (2000). Moral sensibility, understanding of others, and children’s friendship interactions in the preschool period. *British Journal of Developmental Psychology, 18*, 159–177.
- Dunn, L. M., Dunn, L. M., Whetton, C., & Burley, J. (1997). *British Picture Vocabulary Scale* (2nd ed.). Windsor, U.K.: NFER-Nelson.
- Fernyhough, C. (1996). The dialogic mind: A dialogic approach to the higher mental functions. *New Ideas in Psychology, 14*, 47–62.
- Flavell, J. H., Flavell, E. R., & Green, F. L. (1983). Development of the appearance–reality distinction. *Cognitive Psychology, 15*, 95–120.
- Fonagy, P., & Target, M. (1997). Attachment and reflective function: Their role in self-organization. *Development and Psychopathology, 9*, 679–700.
- Happé, F. G. E. (1995). The role of age and verbal ability in the theory of mind task performance of subjects with autism. *Child Development, 66*, 843–855.
- Harris, P. L. (1996). Desires, beliefs, and language. In P. Carruthers & P. K. Smith (Eds.), *Theories of theories of mind* (pp. 200–220). Cambridge, U.K.: Cambridge University Press.
- Harris, P. L., & Leivers, H. J. (2000). Pretending, imagery and self-awareness in autism. In S. Baron-Cohen, H. Tager-Flusberg, & D. J. Cohen (Eds.), *Understanding other minds: Perspectives from developmental cognitive neuroscience* (2nd ed., pp. 182–202). Oxford, U.K.: Oxford University Press.
- Hogrefe, G. J., Wimmer, H., & Perner, J. (1986). Ignorance versus false belief: A developmental lag in attribution of epistemic states. *Child Development, 57*, 567–582.
- Holmes, H. A., Black, C., & Miller, S. A. (1996). A cross-task comparison of false belief understanding in a Head Start population. *Journal of Experimental Child Psychology, 63*, 263–285.
- Hughes, C., & Dunn, J. (1998). Understanding mind and emotion: Longitudinal associations with mental-state talk between young friends. *Developmental Psychology, 34*, 1026–1037.
- Jenkins, J., & Astington, J. W. (1996). Cognitive factors and family structure associated with theory of mind development in young children. *Developmental Psychology, 32*, 70–78.
- Lewis, C., Freeman, N. H., Kyriakidou, C., Maridaki-Kassotaki, K., & Berridge, D. M. (1996). Social influences on false belief access: Specific sibling influences or general apprenticeship? *Child Development, 67*, 2930–2947.
- Meins, E. (1997a). Security of attachment and maternal tutoring strategies: Interaction within the zone of proximal development. *British Journal of Developmental Psychology, 15*, 129–144.
- Meins, E. (1997b). *Security of attachment and the social development of cognition*. Hove, U.K.: Psychology Press.
- Meins, E., & Fernyhough, C. (1999). Linguistic acquisitional style and mentalising development: The role of maternal mind-mindedness. *Cognitive Development, 14*, 363–380.
- Meins, E., Fernyhough, C., Fradley, E., & Tuckey, M. (2001).

- Rethinking maternal sensitivity: Mothers' comments on infants' mental processes predict security of attachment at 12 months. *Journal of Child Psychology and Psychiatry*, 42, 637–648.
- Meins, E., Fernyhough, C., Russell, J., & Clark-Carter, D. (1998). Security of attachment as a predictor of symbolic and mentalising abilities: A longitudinal study. *Social Development*, 7, 1–24.
- Nunnally, J. (1967). *Psychometric theory*. New York: McGraw-Hill.
- Nunnally, J. (1978). *Psychometric theory* (2nd ed.). New York: McGraw-Hill.
- Pedhazur, E. J., & Schmelkin, L. P. (1991). *Measurement, design and analysis: An integrated approach*. Hillsdale, NJ: Erlbaum.
- Perner, J. (1991). *Understanding the representational mind*. Cambridge, MA: MIT Press.
- Perner, J., Ruffman, T., & Leekam, S. R. (1994). Theory of mind is contagious: You catch it from your sibs. *Child Development*, 65, 1228–1238.
- Ruffman, T., Perner, J., Naito, M., Parkin, L., & Clements, W. A. (1998). Older (but not younger) siblings facilitate false belief understanding. *Developmental Psychology*, 34, 161–174.
- Saarni, C. (1984). An observational study of children's attempts to monitor their expressive behavior. *Child Development*, 55, 1504–1513.
- Wimmer, H., & Perner, J. (1983). Beliefs about beliefs: Representation and constraining function of wrong beliefs in young children's understanding of deception. *Cognition*, 13, 103–128.