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### Abstract

Data are presented from a longitudinal investigation examining the relationship between maternal mind-mindedness in infancy and socio-cognitive development in childhood. We revisited children ( $n = 18$ ) who had taken part in a longitudinal study as infants. Mind-mindedness had been assessed at 10, 12, 16, and 20 months of age. We followed-up these children at age 5 to 6 years to test their higher order Theory of Mind (measured using the Strange Stories task, Happé, 1997). The convergent validity, temporal stability, and predictive validity of the construct of mind-mindedness were examined in a longitudinal dataset. The five measures of mind-mindedness were not significantly correlated. Mother's production of appropriate mind-related comments (but no other measures) showed evidence of temporal stability throughout infancy. Thus mind-mindedness (as measured by appropriate mind-related comments) was confirmed as a stable construct. Children's Theory of Mind at age 5 to 6 was significantly predicted by their mother's mind-mindedness up to four years earlier, with mind-mindedness accounting for 40% of the variance of the Strange Stories task scores. These findings identify a relationship between mind-mindedness across a protracted period of infancy and socio-cognitive development at age 5 to 6.

**Key words:** Theory of mind, mind-mindedness, longitudinal, social-cognitive development

## **A longitudinal investigation of the relationship between maternal mind-mindedness and theory of mind.**

Early expressions of symbolic thought emerge in infancy, expressed through nonverbal and often preverbal behaviours (DeLoache, 2004; McCune-Nicholic, 1977; Piaget, 1962). An infant might pretend to drink from an empty cup, close her eyes and pretend to sleep, or flap her arms to tell her mum that there is a bird outside. In turn, caregivers foster the development of symbolic thought through their own speech and action. They engage in pretend play with children and gesture symbolically, for example holding up empty hands to indicate that a snack is 'all-gone'. Parents interpret their child's behaviour by making inferences about their thought processes, perhaps they are *frustrated* that they cannot open the door of the toy fire engine or that they *want* their favourite book when reaching to the shelf. In appropriately labelling a child's mental states in this way, parents are demonstrating mind-mindedness (MM) (Meins, Fernyhough, Fradley, & Tuckey, 2001). When parents label these thoughts and feelings they likely nurture the child's ability to understand their own mental state and attribute mental states to others (Meins et al., 2002).

The construct of MM was developed from a re-evaluation of maternal sensitivity and refers to a parent's proclivity to treat the infant as "an individual with a mind rather than merely as a creature with needs that must be satisfied" (Meins et al., 2001, p.638). Early work by Meins and colleagues measured MM on five dimensions, including: maternal responsiveness to change in infant's direction of gaze, maternal responsiveness to infant's object-directed action, imitation of infant vocalizations, encouragement of autonomy, and appropriate mind-related comments (Meins et al., 2001). In recent years, MM has been redefined in terms of mind-related comments, rather than a mother's general proclivity to treat her infant as an individual with a mind (Meins et al., 2001). Studies have examined the role of MM in children's socio-cognitive development and have identified appropriate mind-

related comments during the child's first year as a positive predictor of early aspects of Theory of Mind (ToM) at age two (Laranjo, Bernier, Meins, & Carlson, 2010) and a child's ability to pass ToM tasks at age four (Laranjo, Bernier, Meins & Carlson, 2014; Meins et al., 2003; Meins, Fernyhough, Arnott, Leekham & de Rosnay, 2013). Beyond infancy, mind-mindedness can be assessed via a caregivers' tendency to focus spontaneously on mental and emotional attributes when describing their child (Meins, Fernyhough, Russell, & Clark-Carter, 1998). Using this method, Lundy (2013) has demonstrated maternal and paternal mind-mindedness to concurrently predict ToM performance in four year olds. It is worth noting that what these studies have in common is a focus on discourse-based indices of mind-mindedness.

There remain unanswered questions about the construct of MM, and the relationship between MM and ToM that we sought to address. Firstly, do the behavioural and verbal indices of mind-mindedness measure the same underlying construct? Secondly, is MM stable over time? And thirdly, does mind-mindedness in infancy (considering both behavioural and verbal indices) predict children's ToM at the age of 5 to 6? Our longitudinal data allow us to examine the construct of mind-mindedness and the validity of different indices over time. First, we assess the convergent validity of the five measures of MM observed at 10, 12, 16, and 20 months of age. Previous research has presented data to support a reduction of the construct of MM to a caregiver's tendency to verbalise explicit mentalistic representations of their infants, i.e. mind-related comments (Meins et al., 2003). We test whether the other dimensions of mind-mindedness are associated with mind-related comments at each age of assessment.

Second, the stability of MM will be examined. Meins et al. (2003) hypothesized that continuity of mind-minded discourse during infancy could explain the relationship between appropriate mind-related comments at 6 months and ToM at 45 to 48 months, with high

levels of appropriate mind-related comments at 6 months expected to remain stable throughout infancy. Meins, Fernyhough, Arnott, Turner, and Leekam (2011) reported on the longitudinal stability of maternal MM (focussing on appropriate mind-related comments and non-attuned mind-related comments) from 3 to 7 months of age. Production of both types of mind-related comments was higher at 7 months than at 3 months, with a positive correlation between production at both ages, indicative of temporal stability over a 4-month period. The authors concluded that these discourse-based measures of MM reflect a cognitive-behavioural trait in the mothers, independent of infant age and notwithstanding developmental changes that occur between 3 to 7 months of age. If we are to be confident that MM represents a stable construct rather than a state that would be contingent upon infant characteristics and development, we would expect stability over a protracted period of infancy and ideally one that spans significant motor and linguistic milestones. Thus we seek to shed light on the extent to which mind-related comments and other indices of MM exhibit stability between 8 and 20 months of age.

Third, we wanted to evaluate the potential of MM measured during infancy in predicting a child's higher order mentalizing abilities at the later age of 5 to 6. We sought to examine the relative contributions of the different indices of early MM (identified by Meins et al., 2001) to a child's understanding of minds. Meins (1999) stated that appropriate mind-related comments better reflect a mother's representations of her child's mental states than more behavioural measures. There may, however, be other measures of MM that are also important for children's developing understanding of minds. Laranjo et al. (2010) and Meins et al. (2013) only measured appropriate and non-attuned mind-related comments. Meins et al. (2003) did measure the five dimensions of MM, but only once, at 6 months of age. Moreover, there were few intercorrelations between the measures, indicating little evidence of convergent validity. We consider the possibility that a mother's representation of her infant's

mental states may be expressed differently throughout development as a consequence of the style of interaction that the child's current developmental level affords. Beyond the child's first birthday, advancing physical and linguistic abilities may invite alternative expressions of MM qualitatively different to that observed earlier. These may be as important for the development of socio-cognitive abilities of toddlers as appropriate mind-related comments are for younger infants.

We drew on a rich longitudinal data set of coded video-taped observations of a subsample of 18 mother-infant dyads from a previous longitudinal investigation (reference removed for blind review). This study had examined the impact of encouraging hearing mother-infant dyads to share a gestured system of communication (baby sign) upon a range of child and parent outcomes, including mind-mindedness. Thus, half of the infants in the present sample had experienced a gesture training condition and half had acted as controls (we account for any potential training effect in the analyses). The present study followed-up the same children at age 5 to 6 to assess their higher order ToM using the strange stories task (Happé, 1994). This task is age appropriate for assessing children's (and adults') ability to attribute mental states (e.g. desires, beliefs, intentions) to others and in addition requires higher order mental states such as one character's belief about what another character knows.

By revisiting these children and measuring their higher-order ToM we aimed to explore the relationship between maternal MM and ToM, by testing: (a) the convergent validity of the five measures of MM; (b) the temporal stability of the five measures of MM between 10 – 20 months of age; (c) the predictive validity of the five measures of MM, i.e. the relationship between MM measures during infancy and higher order ToM at age 5 to 6. Because the data were drawn from an empirical investigation of baby sign, we also considered whether children who had experienced gesture training would perform better on the ToM task than children who had been in control conditions.

## Method

### Participants

A subset of a longitudinal sample had already been coded for mind-mindedness ( $n=18$ , see *reference removed for blind review*). These children were followed-up at age 5 to 6. Unfortunately three of these pairs were not available for testing at follow-up, thus resulting in a sample size of 15 for some analyses. As part of the original longitudinal study, dyads had been allocated randomly to either a gesture training condition (British Sign Language, BSL, or symbolic gesture training) or a control condition (verbal training or non-intervention control) when they entered the longitudinal study at age eight months (for details of the intervention please refer to *reference removed for blind review*). All dyads were assessed at 8, 10, 12, 16, and 20 months of age. All mothers were English-speaking and all except one held an undergraduate university degree. Of the 15 children that participated in follow-up at age 5 to 6, 8 had experienced a gesture training intervention (5 males, mean age at testing 70.38 months,  $SD = 3.66$ , range 62-74) and 7 had been in control conditions (4 males, mean age 65.29 months,  $SD = 3.64$ , range 59–69).

### Materials

**Mind-mindedness.** Mind-mindedness was coded at four time points (10, 12, 16, and 20 months of age) using the coding scheme of Meins et al. (2001) (*reference removed for blind review*). Dyads had been filmed in the home engaging in free-play with their mother for 10 minutes. Mothers were simply asked to play with their child as they would do normally if they had a spare ten minutes at home. Toys were supplied (including a teddy bear, baby books, a rubber duck, a soft-toy flower, a child's cup, bowl, and cutlery set) but children were



free to play with their own toys in the home. This set of 72 videotaped observations were subjected to fine-grained coding using Observer XT, a computer aided-coding system.

Every maternal utterance was coded and then classified according to its content as one of five categories: (a) *Appropriate mind-related comments*; accurately describe the thoughts, feelings or desires of the infant in a play context, e.g. “You want to play with the fire engine” – when the infant is reaching for the toy. (b) *Non-attuned mind-related comments*; inaccurately describe the thoughts, feelings or desires of the infant in a play context, e.g. “You don’t like the fire engine” – when the infant seems happy playing with the toy. (c) *Encouraging autonomy comments*; encourage the infant to perform actions independently of the mother, not including demands, e.g. “You get the ball” – the mother stays still and motions at the ball so that the child can retrieve it of their own volition. (d) *Imitation*; direct imitations of an infant’s utterance, without trying to correct speech. (e) *Other*; comments not in the above categories. The proportion of total maternal speech in the session coded as each of these comments was calculated for each session. The use of proportional scores controlled for differences in the verbosity of mothers.

Every *change in infant object-directed action* and *change in infant’s direction of gaze* was coded in the sessions. The maternal response to each of these was then classified as responsive (mother made a comment contingent to the change or physically responded to the change) or not responsive (mother did not acknowledge the infant’s change in action or gaze).

Thus we had a measure of the proportion of maternal speech during each session that was categorised as appropriate mind-related comments, non-attuned mind-related comments, encouraging autonomy comments, and imitation of infant vocalisations, and the proportion of changes in infant object-directed action or direction of infant gaze that mothers responded to.

A second coder independently coded 8 of the 72 videotaped sessions. Kappa (calculated from the five categories) indicated a substantial level of agreement,  $\kappa = .74$ .

**Theory of mind assessment.** Children's mentalizing ability was measured using a number of the original strange stories from Happé (1994). This has been validated as an appropriate clinical assessment tool for advanced theory of mind performance in 5 to 12 year olds (O'Hare, Bremner, Nash, Happé, & Pettigrew, 2009). A total of 12 scenarios (one of each type from Happé's original set of 24) were used which represented; contrary emotions, lies, white lies, persuasion, pretend, joke, forget, misunderstanding, double bluff, figure of speech, appearance/reality, and sarcasm. A short vignette was read aloud to children accompanied by a picture, for example: "One day, while Anna is playing in the house, she accidentally knocks over and breaks her mother's favourite crystal vase. Oh dear, when mother finds out she will be very cross! So when Anna's mother comes home and sees the broken vase and asks Anna what happened, Anna says, "The dog knocked it over, it wasn't my fault!" This story was accompanied by a picture of a young girl standing by a smashed vase on the floor below a table. Children were then asked a comprehension question ("Is it true what Anna said?"), followed by the test question to assess whether the child understood the mental manipulation covered in the story "Why do you think she said that?"). The total number of correct responses to all the strange stories was recorded (maximum score of 12). Two presentation sets were used (Set A and B counterbalanced across participants) to avoid order effects.

**Children's receptive verbal ability.** Children's language was measured at follow-up (age 5 to 6) using the British Picture Vocabulary Scale II (BPVS) (Dunn, Dunn, Whetton, & Burley, 1997). Standardised scores were calculated for each child to provide a measure of their verbal receptive ability.

## Procedure

Children were tested individually in the home. The BPVS II (Dunn et al., 1997) was administered first followed by the strange stories task (Happé, 1994). All sessions were videotaped and lasted approximately 30 minutes.

## Results

The mean scores on the five MM measures at each age of assessment are presented in Table 1, together with the mean Theory of Mind and receptive language scores of the sample at follow-up. Because half of the children had previously completed a gesture training intervention, preliminary analyses were first conducted to test whether this impacted significantly upon their Theory of Mind performance. Mean scores on the strange stories task were compared for children in the gesture training intervention ( $n = 17$ ,  $M = 6.65$ ,  $SD = 2.00$ ) and those in control groups ( $n = 16$ ,  $M = 6.25$ ,  $SD = 1.00$ ). An Analysis of Covariance (ANCOVA) tested the impact of condition (gesture training, control) on children's strange stories score, while controlling for children's language abilities (BPVS standardised score, gesture condition:  $M = 104.47$ ,  $SD = 7.78$ ; control condition:  $M = 109.44$ ,  $SD = 7.75$ ). The ANCOVA showed no significant main effect of intervention type on strange stories score,  $F(1, 30) = .88$ ,  $p = .36$ . Therefore, encouraging preverbal communication in infancy via gesture was not associated with enhanced mentalizing abilities in childhood.

[INSERT TABLE 1 ABOUT HERE]

**Convergent validity of mind-mindedness measures.** Intercorrelations were examined between the mind-mindedness (MM) measures at each age of assessment (see Table 2). There were few significant correlations between the five measures of MM at any

age, suggesting limited convergent validity of the five measures of MM, confirming the results reported by Meins (2001) and Meins et al. (2003).

**[INSERT TABLE 2 ABOUT HERE]**

**Temporal stability and growth of mind-mindedness measures.** Next, the relation within individual measures taken at the four ages of assessment was examined. There was evidence for temporal stability in appropriate mind-related comments, with significant positive correlations between appropriate mind-related comments at 10 months and 12 months ( $r = .51, p = .031$ ); 10 months and 20 months ( $r = .53, p = .024$ ); 12 months and 16 months ( $r = .48, p = .046$ ). There was a significant positive correlation between encouraging autonomy scores at 12 and 20 months of age ( $r = .48, p = .044$ ). Non-attuned mind-related comments at 12 and 16 months were highly correlated ( $r = .86, p < .001$ ). No other correlations reached significance.

Because there was considerable evidence for temporal stability in mother's appropriate mind-related comments, we then investigated the amount of change between the four points of assessment regarding the proportion of appropriate mind-related comments mothers made when playing with their child. Non-attuned comments did not demonstrate the same level of stability and were not related to ToM, thus these were not investigated further. A multi-level model was used to analyse the 18 longitudinal data records (Hox, 2002; Raudenbush, 2001) and establish the shape of the individual growth curves and their variation. A Null-model was fitted first to gauge the extent of systematic variation between subjects (i.e. variation at level-2) as well as variation of the repeated MM observations within subjects at level-1. Both random parameter estimates of the Null-model, the variance for the repeated measures ( $\sigma_e^2 = .00228, \text{Wald-}z = 5.20, p < .001$ ) as well as the person level variance ( $\sigma_{uo}^2 = .00156, \text{Wald-}z = 2.17, p < .03$ ) were statistically reliable, and the resulting

intra-class correlation was  $ICC = .41$  suggesting that less than half of the total variance of appropriate mind-related comments was down to differences between individuals, and the larger part (59%) of the variance down to change over time within the individuals. To account for the individual variation in the growth curves an unconditional linear growth model (i.e. a model with a linear predictor for change over time) was fitted next. This model allowed the individual linear trajectories to vary in terms of their intercepts and slopes. Although this model had 3 parameters more, it did not improve the fit of the Null-model ( $-LL = 210$ ;  $AIC = 204$ ) as its deviance was even slightly larger and the AIC hardly smaller ( $-LL = 211.5$ ;  $AIC = 199.5$ ). The fixed slope parameter for the linear predictor 'time' representing an average growth curve in this sample was not significant ( $t = -.81$ ,  $p = .45$ ), and neither of the two variance components parameters remained statistically significant. Thus, mind-mindedness (expressed as appropriate mind-related comments) did not increase over time.

**Is there a relationship between mind-mindedness in infancy and mentalizing ability in childhood?** We explored the relationship between MM during infancy and children's later mentalizing abilities to test whether MM during infancy would predict higher-order theory of mind at age 5 to 6. Furthermore, because we had assessed MM scores at four time points during the infants' first year we could explore the stability of the relationship between MM and the children's later ability to understand the mental states of others at age 5 – 6 years.

The correlations between the five MM behaviours and children's scores on the strange stories task were examined. Because previous research had reported significant positive correlations between appropriate mind-related comments and subsequent ToM (Laranjo et al., 2010; Lundy, 2013; Meins et al., 2003; Meins et al., 2013), these correlations were tested one-tailed. All other correlations were conducted as two-tailed. Appropriate mind-related comments at 10, 12, and 20 months were significantly positively correlated to children's

score on the strange stories task ( $r = .46, .57, \text{ and } .55$  respectively, one-tailed, Table 3). These are large effects according to Cohen's criteria. Mothers' appropriate mind-related comments during infancy accounted for between 21 – 32 % of the variance in children's subsequent ToM performance at age 5 to 6. These relations were independent of children's age at follow-up and BPVS score as the significant positive correlations remained when these were partialled out. Thus, the extent to which a mother commented appropriately on her child's mental states during infancy positively predicted her child's mentalizing ability up to four years later.

There were no significant relationships between children's strange stories score and the other MM variables (non-attuned mind-related comments, imitation, encouraging autonomy, responsiveness change gaze/action) at any age (10, 12, 16, and 20 months  $p > .05$ ), with the exception of a significant negative correlation between encouraging autonomy score at 12 months only and strange stories score,  $r(13) = -.73, p < .01$ . This relationship remained when age at follow up and BPVS score were controlled for,  $r(9) = -.76, p < .01$ . Thus, the more frequently mothers encouraged autonomy in their infants at 12 months, the lower her child's subsequent score on the strange stories task.

The considerable temporal stability of appropriate mind-related comments provided clear evidence to conceive the underlying construct 'mind-mindedness' as a stable construct. We were therefore interested in developing a prediction model that would enable us to estimate both the construct-specific variance of maternal mind-mindedness as well as its predictive relationship with children's ToM performance at 5 to 6 years. Because the sample size ( $n = 15$ ) was small, we employed Partial Least Squares (Henseler, Ringle, & Sinkovics, 2009; Tenenhaus et al, 2005; Vinzi, Trinchera, & Amato, 2010) as an exploratory model building technique. Thus, a model was specified which included a latent exogenous variable MM-Construct with four reflective indicators (i.e. appropriate mind-related comments at 10,

12, 16, and 20 months) and children's ToM performance as the endogenous variable. We used the standard path weighting scheme for obtaining the parameter estimates and a bootstrapping method to compute their t-values. The results for this model are shown in Figure 1.

[INSERT FIGURE 1 ABOUT HERE]

All four factor loadings of the MM-Construct indicators were substantive to high ( $> .50$ ) and their t-values in excess  $> 3.00$  suggesting that at each point in time appropriate mind-related comments were determined considerably by a mother's score on the latent construct mind-mindedness. The following results were obtained for the MM-Construct; there was only one eigenvalue in excess of 1; it accounted on average for 61% of the variance of the 4 indicators which is regarded as sufficiently high to demonstrate their convergent validity; the reliability of the construct scores was high (Cronbach's alpha = .79), and even higher when using the factor loadings to compute the composite reliability (Dillon-Goldstein roh = .86). Taken together, these results suggest that there was sufficient evidence to regard the measure of appropriate mind-related comments as both unidimensional and robust. Finally, the model's estimate for the predictive relationship between MM-Construct and children's mentalizing abilities was strong,  $\beta = .64$ , 95%-CI,  $LL = .34$ ,  $UL = .80$ ,  $t = 4.86$  accounting for 40% of the variance of the strange story task scores at 5 years (adj.  $r^2 = .36$ ).

## Discussion

The results presented here examined the contribution of mind-mindedness (MM) to socio-cognitive development using repeated measures of MM over a protracted period of infancy. The convergent validity and temporal stability of the construct of MM was

examined. The five measures of MM (Meins et al., 2001) were poorly correlated with one another at any time point showing no convergent validity and hence no evidence emerged to suggest that these measure an underlying global construct of mind-mindedness. Only appropriate mind-related comments showed evidence of temporal stability, with appropriate mind-related comments at 12, 16, and 20 months being predicted by a mother's production of appropriate mind-related comments at an earlier age. An exploratory model revealed considerable stability of the construct 'appropriate mind-related comments' over time representing a mother's proclivity to make appropriate mind-related comments when interacting with her child.

As hypothesised, mothers' comments on her infant's mental states were predictive of ToM three to four years later. Appropriate mind-related comments emerged as the sole significant predictor of children's performance on the strange stories task. This relationship appeared stable, with mothers' appropriate mind-related comments at three of the four assessment points predicting their child's higher-order ToM. While we are cautious in generalizing a finding from a small sample size, we have been rigorous in our examination of these longitudinal data and our findings confirm and extend those that have been reported previously (Laranjo et al., 2010; Meins et al., 2003; Meins et al., 2013). The magnitude of the relationship that we report here is somewhat greater, with appropriate mind-related comments during infancy accounting for 40% of the variance in children's ToM score at age 5 to 6. Previous research by Meins et al., (2003) reported that appropriate mind-related comments at 6 months accounted for 14% of the variance of children's score on ToM tasks. In our model, however, the construct MM was based on multiple points across infancy and thus captures construct specific variance of appropriate mind-related comments. The much higher predictive power of the MM construct scores in comparison to the time-specific predictions



between appropriate mind-related comments and ToM suggests that the latter are very likely to be attenuated by both measurement error and occasion specific factors.

While we had considered the possibility that the other measures of MM might also correlate positively with ToM, we had not anticipated a negative relationship. Encouraged autonomy at 12 months was significantly negatively correlated with children's ToM, thus suggesting that the extent to which mothers focused on encouraging their one-year old infants to act more independently impacted negatively upon the child's acquisition of ToM. Previous findings of Meins et al. (2003) may shed light on this negative relationship. They found that responsiveness to object-directed action when infants were six months was negatively correlated with later understanding of mind (assessed using a stream of consciousness task at age four). Meins et al. (2003) argued that this continued attention to the child's physical movement rather than their mental states is not indicative of MM, hence the negative relationship with subsequent understanding of mind. Taken together, these negative findings highlight the importance of the caregivers' ability to shift focus from the infant's physical actions to an appreciation and articulation of the infant's mental states.

With a relatively small sample size there are clear limitations to the statistical validity of our prediction model, and so we have avoided statistical tests and used robust exploratory statistical methods instead. Furthermore, the correlational nature of our results does not preclude the possibility that the relation between mind-mindedness and ToM is mediated by another underlying variable. Notwithstanding these limitations, our main conclusion is that the underlying construct that enables mothers to make appropriate mind-related comments when interacting with her child is stable in infancy. In other words, there appears to be continuity in a mother's tendency to explicitly label her child's mental states between the ages of 10 to 20 months (thus spanning significant developmental milestones) and that this

exposure to appropriate mental language during infancy facilitates the child's understanding of mind.

While we have found evidence to show that mothers were consistent in their willingness to represent their child's mind, this is not to say that this construct represents a general trait that extends to how the mother views others more generally. Recent research by Meins, Fernyhough, and Harris-Waller (2014) presents evidence to support the conceptualisation of mind-mindedness as a relational construct rather than a trait-like quality. In a series of studies it was found that individuals were much more likely to describe somebody with whom they were in a close relationship in mental terms than somebody they did not know, or an inanimate object. According to this view, the stability in mind-mindedness that we have captured in our investigation reflects a quality of the close relationship between mother and child, which is not dependent on features of the child (i.e. developmental level) and is not a trait of the mother.

Our research adds to a growing body of evidence that demonstrates the critical role of contingent conversational interactions during infancy in fostering a child's socio-cognitive development (Laranjo et al., 2010; Meins et al., 2003; Symons, 2004). While increased exposure to mental state terms is positively related to theory of mind understanding (e.g. Dunn, Brown, & Beardsall, 1991; Dunn, Brown, & Slomkowski, 1991; Ruffman, Slade, & Crowe, 2002), the importance of the contingency of this discourse to the infant's behaviour has been highlighted to be of utmost importance. We have demonstrated relations between MM measures across infancy to ToM at age 5 to 6. From a very young age, appropriate mind-related comments scaffold the infant's burgeoning understanding of the mental states underlying their behaviours, which further serves to equip them with insight into the mental life of others. School-aged children lacking in theory of mind are at risk of a range of negative social outcomes, including loneliness, social rejection, and diminished prosocial

behaviour (Caputi, Lecce, Pagnin, & Banerjee, 2012; Devine & Hughes, 2013; Dockett, 1997; Slaughter, Dennis, & Pritchard, 2002). Given that we have identified a robust link between mother's interactional style and their children's later developmental outcomes in ToM skills, this finding has important practical implications for healthcare professionals working with families. Our research also provides preliminary evidence for considerable stability of the construct mind-mindedness that can be readily measured during childhood, thus allowing at-risk mother-infant dyads to be identified and referred for intervention.

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Table 1

*Mean (SD) Scores on Measures of Mind-Mindedness, Theory of Mind (Strange Stories) and Receptive Language (BPVS)*

	10 months	12 months	16 months	20 months	5 - 6 years
	<i>n</i> = 18	<i>n</i> = 18	<i>n</i> = 18	<i>n</i> = 18	<i>n</i> = 15
Appropriate mind-related comments	.09 (.04)	.11 (.06)	.09 (.06)	.08 (.07)	
Non-attuned mind-related comments	.01(.01)	.01 (.01)	.01 (.02)	.01 (.01)	
Imitation	.09 (.11)	.09 (.11)	.08 (.09)	.13 (.08)	
Encouraging autonomy	.09 (.07)	.09 (.04)	.09 (.05)	.07 (.06)	
Responsiveness to change in gaze/action	.64 (.26)	.58 (.25)	.73 (.22)	.64 (.30)	
Strange stories					6.40 (1.68)
BPVS					107.07 (8.61)



Table 2

Pearson Intercorrelations Between MM Variables by Age (n = 18)

	Encouraging Autonomy	Imitation	Appropriate Mind-Related Comments	Non-attuned Mind-Related Comments
<i>10-month variables</i>				
Imitation	-.01			
Appropriate Mind-Related Comments	.13	-.07		
Non-attuned Mind-Related Comments	-.13	-.01	.17	
Responsiveness	.33	.35	.17	.02
<i>12-month variables</i>				
Imitation	.39			
Appropriate Mind-Related Comments	-.21	-.04		
Non-attuned Mind-Related Comments	-.20	.59*	.32	
Responsiveness	-.13	-.11	-.29	.00
<i>16-month variables</i>				
Imitation	-.36			
Appropriate Mind-Related Comments	-.04	-.14		
Non-attuned Mind-Related Comments	.06	-.27	.48*	
Responsiveness	.24	-.26	-.26	-.23
<i>20-month variables</i>				
Imitation	.38			
Appropriate Mind-Related Comments	-.38	-.28		
Non-attuned Mind-Related Comments	-.18	-.37	.14	
Responsiveness	-.66**	-.14	.26	-.18

Responsiveness = maternal responsiveness to change in infant gaze or object directed action.

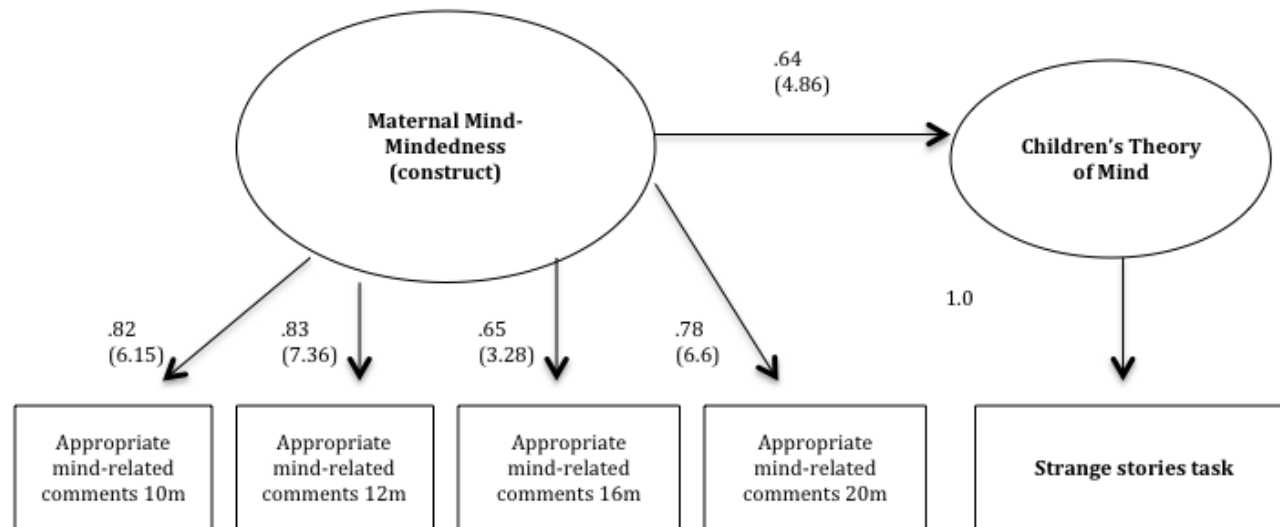
\* $p < .05$ , \*\* $p < .01$ , two-tailed.

Table 3

Correlations (Pearson's  $r$ ) Between Appropriate Mind-Related Comments, Strange Stories Score, BPVS Score and Age.

	Appropriate Mind-Related Comments				Control Variables	
	10 Months	12 Months	16 Months	20 Months	Chronological Age at Follow-Up	BPVS Score
Strange Stories	.46*	.57*	.17	.55*	.46**	.10
Strange Stories (Controlling for BPVS Score)	.48*	.57*	.18	.61**	.32	

\*significant at  $p < .05$ , one-tailed\*\*significant at  $p < .01$ , one-tailed



Note: parameter estimates are standardized with t-values in brackets

Figure 1. Prediction model for children's mentalizing abilities at age 5- 6 years based on maternal mind-mindedness composite scores