



## The relationship of maternal mentalization and executive functioning to maternal recognition of infant cues and bonding

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The study examined associations between maternal mentalization ability, executive functioning, recognition of infant cues, and bonding in a non-clinical sample of mothers. It employed a correlational design. Sixty-four mothers of young infants completed assessments of mentalization ability, executive functioning, and bonding. Photographs of infant facial expressions were utilized to assess ability to recognize infant cues of emotion, but this was not found to correlate with either maternal mentalization or executive functioning ability. Whilst a trend towards a significant positive relationship between mothers' cued ability to attribute mental states and their ability to recognize infant facial expressions was observed, no significant relationships were found between bonding scores and performance on the executive functioning and mentalization measures. The present study contributes to our current understanding of the influence of maternal cognitive factors, specifically mentalization and executive functioning, on the development of the mother–infant relationship. Future research, methodological issues, and clinical and theoretical implications are discussed.

The relationship that exists between human infants and their primary caregivers and the interactions that occur within this relationship are crucial to the infant's physical, social, cognitive, and emotional development. It has been argued that the development of symbolic representation, memory, language, and thought are all strongly influenced by attachment and the special kind of fit between adult and infant behaviour (Siegel, 1999). To date, there has been a paucity of research relating to the bonding process since the refutation of the concept of a critical period (Herbert, Sluckin, & Sluckin, 1982). Although bonding can be synonymous with attachment, in this context it is defined as the mother's perception of her relationship with her young infant, which is distinct from the dynamic, interactional, and observable relationship of attachment (Reber, 1985).

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Although a study looking at bonding by Kumar (1997) found significant links between disorders of maternal affection (bonding) and postnatal psychiatric disorder, the main focus of research to date has been on the attachment process and how this is influenced by social cognitive processes on the part of mothers, for example due to psychological difficulties or learning disabilities. In the latter case, there is an increased risk of neglect (Schilling, Schinke, Blythe, & Barth, 1982) possibly related to a reduced capacity for responding appropriately to the child, due to impaired maternal capacity for formal operational or abstract cognitive functioning (Sheerin, 1998). This would indicate that a mother's ability to plan, organize, and switch approaches based on negative feedback may be crucial with regard to her responses to her infant and the formation of a positive relationship. The nature of these difficulties indicates that mentalization ability (also termed meta-cognitive capacity, theory of mind ability or reflective function) and/or executive functioning are likely to be important causal and/or mediating factors in the development of bonding. In the widest sense, mentalization refers to the ability to attribute mental states, thoughts and feelings to both oneself and to other people in order to predict and explain behaviour. Similarly, executive functioning refers to the capacity to undertake independent purposive actions (Mesulam, 2002) and involves skills in planning, initiating, monitoring, and regulating one's own behaviour and emotional responses, and the generation of multiple responses to situations, as well as the motivation to undertake such actions (Lezak, Howieson, Loring, & Hannay, 2004). Executive functioning and mentalization are related processes, but the nature of their relationship remains undetermined (Bach, Happe, Fleming, & Powell, 2000; Russell, 1997).

Maternal mentalization ability has been found to be predictive of attachment security at 12 months (Meins, Fernyhough, Fradley, & Tuckey, 2001) as well as impacting on the consequent development of children's own mentalization abilities (Meins *et al.*, 2002). Meins *et al.* view maternal mentalization ability as consisting of five dimensions of mind-mindedness: (1) maternal responsiveness to change in infant's direction of gaze; (2) maternal responsiveness to infant's object-directed action; (3) imitation; (4) encouragement of autonomy; and (5) making appropriate mind-related comments. The latter dimension is akin to mental inference that is the ability to infer, recognize and name mental states in another person. In this context, it is the latter we are interested in assessing. To date there is no comparable work on executive functioning ability and parenting/mentalization ability.

Both maternal mentalization and executive functioning can be considered *a priori* as involving the processing of information derived from the infant which, given the non-verbal nature of infants under 24 months, is derived from infant behaviour and expression, the latter being the primary source of information about the infant's emotional state (Izard, Huebner, Risser, McGinnes, & Dougherty, 1980). Infant emotions are highly organized, biologically prepared communication signals that facilitate infants and caregivers in the process of adaptation and 'fitting together' (Emde, 1993). In the early months after birth, the emotions that are primarily expressed are distress and pleasure, with varying degrees of interest and arousal. By 6 months old, joy, anger, surprise, fear, sadness, disgust, and interest develop (Izard *et al.*, 1980). Emotional signals communicate need and are in-turn dynamically influenced by the feedback received from caregivers. Thus, it is crucial that mothers are sensitive and responsive to their infant's emotional cues in a consistent way, not only in order to meet the infant's physical and emotional needs, but also to promote development of infant emotional expression and communication. Prompt effective caregiver responses to infant signals

are associated with secure attachment and less maladaptive behaviour (Ainsworth, Blehar, Waters, & Wall, 1978; Meins *et al.*, 2001).

It has been proposed that maternal mentalization has a significant resilience-enhancing role in reducing infant insecurity (Fonagy *et al.*, 1995; Main, 1991), and that the mother must reflect to the infant an appreciation of his or her emotional state whilst responding in a way that indicates that she is not overwhelmed by infant distress. Hence, the mother's ability to first interpret infant cues correctly appears to be linked to her mentalization ability, and her interpretation of cues may then influence the mother–infant relationship. It is also possible that mentalization abilities and ability to interpret infant cues are not linked, but that mentalization ability exerts its influence through impacting on maternal behaviour *following* correct interpretation of infant cues.

No research to date has considered the impact of executive functioning on mothers' responses to their infants, bonding or the interpretation of infant cues, such as facial expressions. If executive functioning skills of planning, selecting goal-directed behaviours and emotional and behavioural regulation are limited, this may well limit a mother's ability to initiate a response to her infant. If a mother initiates a response, but the infant communicates that this is not the correct response, she must have the cognitive flexibility to generate alternative responses and change her behaviour. Executive functioning may have a direct influence on the mother–infant relationship (bonding). It is also possible that executive functioning may influence correct interpretation of infant facial expressions through the executive skills of attending to a task, blocking over-learned responses and persisting in the face of distractions. However, these cognitive processes can be influenced by mood (Lezak *et al.*, 2004). Furthermore, the specific negative impact of maternal post-partum emotional difficulties on the mother's ability to relate to her child has been demonstrated (e.g. Kumar, 1997); even in community samples of mothers without diagnosable postnatal depression negative beliefs about motherhood and bonding are prevalent (Hall & Wittkowski, 2006). Thus, the assessment of anxiety and depression becomes necessary when investigating these relationships.

The present study explored the relationships between maternal mentalization and executive functioning abilities and (1) recognition of emotion cues in infants and (2) bonding in a non-clinical sample. We predicted that (a) maternal scores on a mentalization test and (b) that measures of executive functioning would be positively correlated with recognition of infant cues and bonding. In addition, mentalization ability was expected to be associated with executive functioning, while bonding was expected to be associated with mood. Finally, it was predicted that recognition of infant emotions would be a co-variate with respect to the relationship of both mentalization and executive functioning with maternal perceptions of bonding.

## Methods

### Participants

Of a total of 104 mothers who were approached with regard to the study, 64 (61.54%) mothers of infants aged between 3 and 48 weeks were recruited through two routine baby clinics serving mostly white British populations from a range of economic backgrounds. Age range for babies was set at 0–52 weeks as an appropriate, preverbal age for assessing aspects of mother–infant relationships. In order to meet consent and

recruitment criteria, mothers were excluded from the study if they were under 18 years of age, had difficulties understanding written or spoken English or had acquired head injury (in order to be able to complete psychometric and neuropsychological tests). Demographic information collected included: mother's age; marital status; nationality; number of children; child/children's ages; and whether they had ever visited a psychiatrist or been diagnosed with a psychiatric illness. Information on educational attainment and socio-economic status were not collected. All participants were white British with the exception of one British Asian participant.

### **Assessment measures**

The *Projective imagination test* (PIT; Blackshaw, Kinderman, Hare, & Hatton, 2001) is a measure of spontaneous and cued mentalization ability, comprising four drawings of neutral social situations (woman entering a house; boy standing under a lamppost; man and woman by a sofa; boy and girl in the countryside). Participants are initially asked to produce a narrative for each picture ('Tell me what is happening in this picture') and are then cued to produce further descriptions of explicit references to mental states ('What is s/he thinking?'; 'What is s/he feeling?'). The mean number of combined mental states (e.g. happy, sad, thoughtful, nervous, etc.) and mental processes (e.g. thinking, planning, feeling, remembering, etc.) produced by each person across the four scenarios can then be recorded for both spontaneous and cued conditions. The PIT is independent of verbal ability and has good inter-rater reliability (Blackshaw *et al.*, 2001).

The *Hayling and Brixton tests* (Burgess & Shallice, 1997) and the *color trails test* (D'Elia, Satz, Uchiyama, & White, 1996) are measures of executive functioning and were used to assess ability to suppress over-learned responses, to measure concept attainment and error correction as well as sustained visual scanning and sequencing. The Hayling test involves completing sentences as quickly as possible with an unrelated word that is suppressing an automatic response. The Brixton test involves determining the position of a coloured circle in an array of circles by use of a simple rule, which may vary without warning. The test-retest reliability of the Hayling and Brixton tests is reported to be satisfactory (.52-.78) (Burgess & Shallice, 1997). The color trails test is a variant of the trail making test developed as a measure of attention and having test-retest reliability coefficients of between .6 and >.9 (Spreeen & Strauss, 1991). The test involves a page of circles numbered from 1 to 25, with odd numbers being pink and even numbers yellow, which have to be linked in numerical order by drawing a line between them, followed by a variant in which the yellow circles are numbered to 13 for odd numbers, the pink circles to 12 for even numbers: the task being to follow the number series alternating with the colours. Both sets of tests have been standardized on populations between 18 and 80 years of age.

*Infant facial expressions of emotions from looking at pictures* (IFEEL; Emde, Butterfield, & Osofsky, 1987) is an assessment tool consisting of 30 photographs of infant facial expressions. All of the infants in the photographs are 12 months old. Participants are asked to state one word that is the 'strongest and clearest feeling that each baby is expressing'. Responses are classified as belonging to a specific emotion category such as surprise or anger. A total score for accuracy of responses can be obtained by comparing participants' responses with those of the 'reference sample' used to determine the psychometric properties of the tool. Responses have been shown to be reliable over short- and long-term test-retest analyses (Appelbaum, Butterfield, & Culp, 1993).

The *post-partum bonding questionnaire* (PBQ; Brockington, Fraser, & Wilson, 2006; Brockington *et al.*, 2001) is a self-report measure of maternal perception of the mother–infant relationship. The PBQ was devised to screen for disorders in the early mother–infant relationship and it is one of the most widely used measures assessing bonding (Brockington *et al.*, 2006; Moehler, Brunner, Wiebel, Reck, & Resch, 2006). Mothers are asked to rate 25 statements on a 0 to 5-point scale (with some items being reverse scored). Examples include ‘I feel close to my baby’ and ‘My baby irritates me’. High scores suggest poor bonding. The PBQ has four subscales with associated cut-off scores to indicate difficulties in the areas of impaired bonding (a general factor) (>12), rejection and anger (>17), infant-focused anxiety (>10), and incipient abuse (>3). For the purpose of this study, a total score was also calculated in line with recommendations based on empirical findings, including the factor structure of the PBQ (e.g. Moehler *et al.*, 2006; Wittkowski, Wieck, & Mann, 2007). It has good convergent and concurrent validity (Wittkowski *et al.*, 2007) and the internal consistency of the PBQ’s total score is reported to be .8 (Moehler *et al.*, 2006; Wittkowski *et al.*, 2007).

The *Beck depression inventory-II* (BDI-II; Beck, Steer, & Brown, 1996) and *Beck anxiety inventory* (BAI; Beck, 1990) are self-report measures assessing symptoms of depression and anxiety. The BDI-II and BAI were used in preference to specific measures of maternal psychopathology, such as the Edinburgh postnatal depression scale (Cox, Holden, & Sagovsky, 1987), as they provide severity ratings. As this study utilized a community sample of mothers, both measures were used in order to assess the potential influence of post-partum mood disturbances. The BDI-II consists of 21 statements, each rated on a four-point scale (ranging from 0 to 3). Scores are aggregated to a total score, which is suggestive of normal mood (0–9), mild (10–18), moderate (19–29), and severe (30–63) depression. Beck and colleagues devised the original BDI in 1961 and since then it has been used in numerous studies, with excellent psychometric properties of split-half and test–retest reliability and concurrent validity with clinician ratings of depression severity (e.g. Beck *et al.*, 1996). The BAI provides a list of 21 adjectives describing states of anxiety, which are rated on a four-point scale, similar to the BDI-II. Scores are categorized as normal mood (0–9), mild (10–18), moderate (19–29), and severe (30–63) anxiety. The BAI also has excellent psychometric properties of good internal consistency, test–retest reliability, and convergent and discriminant validity (Beck & Steer, 1991).

### **Procedure**

All participants were seen by the same researcher (JMT) at the baby clinic they normally attended or at their own home. All responses were fully anonymized and the research had ethical approval from both University and UK National Health Service research ethics committees. All analyses were carried out using SPSS for Windows (version 11; SPSS, Inc. Chicago, IL). *Z* scores generated for skewness and kurtosis indicated that the data were not normally distributed and that the use of non-parametric tests of significance was appropriate. When appropriate, means and standard deviations (*SDs*) are also presented for comparison purposes. Mann–Whitney *U* tests were undertaken for group comparisons. Spearman correlations were used to process associations between variables. Given the number of correlation coefficients being calculated, the significance level was set at the more conservative *p*-value of .01 in order to reduce the likelihood of Type 1 errors (Field, 2005).

## Results

### **Participant characteristics**

Participants' ages ranged from 18 to 42 years (mean age = 28.59,  $SD = 5.84$ ). The number of children of participants ranged from one to five (mode = 1, mean = 1.59,  $SD = 0.87$ ); the majority of mothers had only one child (59.4%). The age of each mother's infant ranged from 0.75 (3 weeks) to 12 months (mean = 4.23 months,  $SD = 2.85$ ). The majority of mothers were married or had a partner (87.5%), and did not report experiencing mental illness (89.06%). Mothers were asked to state whether they had ever been diagnosed with a mental illness or visited a psychiatrist. Six mothers had previously experienced depression but had no current symptoms; one mother currently experienced postnatal depression, while another mother currently experienced anxiety and depression. Both took antidepressant medication.

In addition, comparisons between primiparae and multiparae women indicated that experienced mothers (i.e. those with more than one child) did not significantly differ in terms of depression, anxiety, bonding, spontaneous, and cued PIT scores, infant facial recognition, Hayling and Brixton scores, compared to mothers of only one infant. A significant difference was observed for Test 1 of the CTT ( $t = 2.22$ ;  $df = 62$ ;  $p = .03$ ) as experienced mothers responded more quickly (mean = 26.5,  $SD = 7.42$ ) compared to primiparae women (mean = 36.61,  $SD = 7.93$ ).

### **Mentalization**

Mothers gave a mean of 1.05 ( $SD = 1.13$ ) mental states on the uncued version of the PIT and a mean of 2.81 ( $SD = 1.41$ ) on the cued version that is they generated more responses when specifically asked what the person in the drawing was thinking or feeling. In order to assess inter-rater reliability, 25% of the PIT data was double-scored by a second rater experienced in the use of the PIT but blind to the presented study. This indicated a range of agreement between 75 and 90% depending on the PIT drawing in question. The scores from the first rater were used in all subsequent analyses (Table 1).

### **Executive functioning**

Participants' performance on executive functioning tests was within the normal range. On the Hayling test response latencies were low (i.e. they responded quickly) and scaled scores were high. On the overall scaled score, 48 (75%) participants obtained a score within the 'average' category or above. On the Brixton test, 56 (87.50%) participants obtained a scaled score classified as 'average' or above. On the color trails test, participants performed at or above the normative level (see Table 1).

### **Infant facial expressions of emotions from looking at pictures**

The IFEEL data were analysed in two ways. Accuracy of responses was assessed by comparing responses to each picture to data generated by the test's creators from a reference sample of 145 mothers (Emde *et al.*, 1987), which had similar demographic characteristics to the present sample with the exception of being drawn from the USA. The reference sample data showed the percentage of mothers from the sample who responded with each categorical response for each picture (e.g. Picture 1 = 30.34% for joy, 2.76% for surprise, etc.). For each participant response in this study, the response category was matched against the percentage for the reference sample. If this was 15% or above, the response was considered to be correct. If the

**Table 1.** Mean, standard deviations, medians, and ranges for executive functioning tests, mentalization test, IFEEL pictures, bonding, and mood ( $N = 64$ )

Test	<i>M</i>	<i>SD</i>	Median	Range
Hayling				
Test 1 – Response latency scaled score	4.77	1.61	5	1–7
Test 2 – Response latency scaled score	5.91	0.68	6	4–7
Test 2 – Error scaled score	6.86	1.47	7	1–8
Overall scaled score	5.78	1.15	6	2–8
Brixton				
Error scaled score	6.37	1.32	7	2–10
CTT				
Test 1 – Score (seconds)	33.17	7.96	31	16–57
Test 2 – Score (seconds)	65.92	17.87	63.5	37–131
Interference index	1.04	0.57	0.96	0.25–3.23
PIT				
Uncued responses	1.05	1.13	0.75	0–5.75
Cued responses*	2.81	1.41	2.38	0.50–6.25
IFEEL				
Total score	19.97	3.62	19	12–27
PBQ				
Post-partum bonding total score	8.97	6.17	7	0–34
BDI-II				
Beck depression inventory total score	8.47	7.37	6.5	0–31
BAI				
Beck anxiety inventory total score	5.55	6.09	3.5	0–29

\*Data normally distributed.

response was less than 15%, the response was classified as incorrect. Thus, a total score out of 30 pictures was generated. These scores are demonstrated in Table 1. The second method of scoring the data followed from the authors' (Emde *et al.*, 1987) suggestion that the overall profile of emotion categories might be more useful in identifying individuals who were at risk of neglecting or harming their infants. The number of responses to pictures in each emotion category was generated for each participant (out of a total of 30 pictures) (see Table 2). This was then compared to the average number of responses in each emotion category for the reference sample. All means fell within one *SD* of the means of the reference sample, suggesting that the participants overall showed similar interpretations to the reference sample and that there were no significant differences due to culture or language usage.

### **Bonding**

Overall, this group of mothers bonded very well with their infants. Only three mothers (4.69%) obtained scores above the clinical cut-off on the impaired bonding subscale, suggesting some difficulties. No mothers obtained scores above the clinical cut-offs for scales 2–4. The total PBQ score is comparable to other studies using non-clinical volunteers (Moehler *et al.*, 2006). For the purpose of this study, only the total score was used for further analyses.

**Table 2.** Data from emotion category responses on the IFEEL pictures and comparison with the reference sample

Emotional category	Surprise	Interest	Joy	Content	Passive	Sad	Shy	Guilt	Disgust	Anger	Distress	Fear	Other
$M_{\text{Reference}}$ sample (SD) ( $N = 145$ )	2.98 (2.50)	5.89 (3.80)	3.56 (1.86)	3.75 (2.55)	0.66 (1.34)	3.50 (2.87)	3.08 (2.79)	0.02 (0.13)	0.08 (0.32)	0.91 (1.35)	3.89 (2.14)	1.67 (2.15)	0.02 (0.13)
$M$ (SD)	1.67 (1.37)	7.23 (3.42)	3.36 (1.30)	2.82 (1.54)	1.12 (1.35)	3.75 (2.31)	2.46 (2.03)	0.13 (0.41)	0.27 (0.74)	1.88 (1.67)	2.22 (1.94)	1.94 (1.35)	0.81 (1.21)
Median (Range)	3.00 (0–11)	5.00 (0–14)	3.00 (1–10)	3.00 (1–10)	0.00 (0–8)	3.00 (0–12)	3.00 (0–12)	0.00 (0–1)	0.00 (0–2)	0.00 (0–6)	4.00 (0–11)	1.00 (0–11)	0.00 (0–1)

### **Depression and anxiety**

BDI-II and BAI scores indicated minimal levels of mood disturbance. On the BDI-II, 43 (67.19%) obtained a score within the normal range, 15 (23.44%) within the mild-moderate range, five (7.81%) within the moderate-severe range, and only one (1.56%) within the severe range of depression. On the BAI, 51 (79.69%) obtained scores reflecting normal levels of anxiety, nine (14.06%) scored within the mild-moderate range and four (6.25%) scored within the moderate-severe range. Participants were not excluded from further analyses on the basis of their post-partum mood scores.

### **Correlational analyses**

#### *Mentalization*

No significant correlations were found between uncued number of mental states produced on the PIT and total score on the IFEEL pictures ( $\rho = .19, p = .063$ ), but an almost significant positive correlation was observed between cued number of mental states and the total score on the IFEEL pictures ( $\rho = .30, p = .016$ ) (Table 3). Similarly, no significant relationships were found between uncued and cued PIT scores and each of the 12 emotion categories of the IFEEL, nor with the total PBQ score.

#### *Executive functioning*

There were no significant relationships between any of the measures of executive functioning and the IFEEL scores (see Table 3) nor the PBQ score.

#### *Bonding*

Bonding was not significantly related to mentalization, executive functioning, or recognition of infant facial expressions. A positive correlation was observed between PBQ and BDI-II scores ( $\rho = .53, p < .001$ ), suggesting that depressed mothers perceived themselves to have bonded less well with their infants. A similar trend was observed for anxious mothers ( $\rho = .30, p < .02$ ).

#### *Relationship between mentalization and executive functioning*

Contrary to previous research and our hypotheses, mentalization and executive functioning were not correlated in this study. Further inferential statistical analyses in the form of a series of semi-partial correlations were carried out in order to examine the relationship of depression and anxiety scores as well as of infant age on the main variables, including executive functioning, mentalization, recognition of infant facial expressions and bonding. No significant relationships were identified. It was not possible to statistically control for the possible relationship of infant age and depression with mentalization and executive functioning, as partial correlations and mediator/moderator analyses can only be conducted when all variables correlate with each other (Field, 2005). Neither mood scores nor infant age correlated with performance on the mentalization or executive functioning tasks.

#### *Depression and anxiety*

As expected, both mood measures positively correlated with each other ( $\rho = .62, p < .001$ ). Significant associations were also observed for BDI depression scores and the Hayling error scaled score ( $\rho = -.42, p = .001$ ) and Hayling overall scaled score

**Table 3.** Spearman's correlation coefficients (N = 64)

	Maternal age	Infant age	PBQ total	BDI-II	BAI	S-PIT	C-PIT	IFEEL
Infant age	.06							
PBQ total	-.03	-.25*						
BDI-II	-.14	-.25*	.53**					
BAI	-.36**	-.03	.3*	.62**				
S-PIT	.06	-.01	.16	.01	.06			
C-PIT	.08	-.19	.14	-.07	-.04	.52**		
IFEEL	.37** <i>p</i> = .003	.07	-.02	-.11	-.04	.19	.30*	
Hayling 1 latency scaled score	.19	.08	.07	-.02	-.05	.01	.11	.2
Hayling 2 latency scaled score	-.08	.01	-.21	-.22	-.19	-.03	-.02	.21
Hayling 2 error scaled score	.07	.03	-.17	-.42**	-.22	.04	.06	.13
Hayling total scaled score	.04	.08	-.14	-.27*	-.18	-.01	.04	.24
Brixton test raw	-.01	.07	.09	.12	.04	-.15	-.16	-.04
Brixton scaled	-.02	-.06	-.04	-.1	.01	.11	.16	.06
CTT 1 raw	-.003	.11	.17	.09	.07	-.08	-.2	-.09
CTT 1 scaled	-.02	-.11	-.16	-.08	-.06	.07	.2	.07
CTT 2 raw	-.1	.22	-.01	-.16	.04	.06	-.18	-.08
CTT 2 scaled	.27*	-.20	.02	.16	-.09	-.04	.15	.17

\**p* < .05; \*\**p* < .01.

( $\rho = -.27$ ,  $p = .03$ ). Therefore, the current finding suggests that depressed mothers rated their relationship to their child less favourably, experienced more anxiety and made more errors on the Hayling test.

As noted above, both depression and anxiety scores were positively correlated with bonding as measured by the PBQ.

#### *Infant age*

Given the age range of the infants included in this study, Spearman correlation coefficients were calculated in order to examine if infant age was associated with maternal variables. Mothers of younger infants tended to have bonded less well with their infants ( $\rho = -.25$ ,  $p = .04$ ) and to be more depressed ( $\rho = -.25$ ,  $p = .04$ ). A significant negative correlation was also found between infant age and score on item 16 ('changes in sleep pattern') of the BDI-II ( $\rho = -.50$ ,  $p \leq .001$ ). This suggests that sleep deprivation may be influencing mood of mothers with younger infants. There were no other significant associations with infant age and correlations between infant age and depression score and infant age and bonding were no longer significant when the stricter significance level of  $p < .01$  was adopted.

## **Discussion**

This study explored the relationships between maternal mentalization ability, executive functioning, recognition of infant facial cues and bonding. We predicted that maternal scores on a mentalization test and scores on executive functioning measures would each be positively correlated with recognition of infant cues and bonding. We also predicted that executive functioning tasks would be associated with mentalization ability and that bonding would be associated with mood.

The analyses yielded results that did not support some of the hypotheses, in particular there were no significant associations found between any of the measures of executive functioning and the IFEEL measure of infant facial expressions, nor between executive functioning and bonding. This suggests that ability to detect and interpret emotions from infant facial expressions is not directly related to differences in executive functioning measured on the current set of tasks. Further research is required to determine whether this finding holds for other aspects of executive functioning. As the correlation between the scores for emotions and the second Haying test (involving divided attention and the ability to simultaneously track and alternate between a number sequence and a colour sequence) came close to significance, it would be worthwhile for future work to examine whether a stronger relationship might hold in cases where executive function fell outside of the normal range, as in participants with learning difficulties. A positive relationship was found between mothers' cued ability to attribute mental states and their ability to recognize infant facial expressions. This relationship was significant if no correction was made for multiple comparisons and only narrowly missed significance at the conservative 0.01 significance threshold that we adopted. This tentatively supports an association between mentalization and recognition of infant emotions. Although no comparable relationship was found between spontaneous use of mentalization abilities and recognition of facial expressions, the cued PIT task may be a more accurate measure of mentalization abilities. The cued PIT task is comparable to other measures used with participants being requested to explicitly focus their attention on specific tasks. Given the testing

milieu, in the spontaneous PIT condition, mothers may not have volunteered as many mental states, possibly because this was not explicitly requested of them. As with executive functioning and contrary to hypotheses, no significant correlations were found between the mentalization scores and the scores on the self-report measure of bonding (PBQ). A self-report measure will only assess mothers' perceptions of their relationship with their infant, with mothers possibly reticent to endorse socially undesirable items on the PBQ, despite assurances of confidentiality (Fife-Schaw, 2000). In particular, mothers with postnatal depression have been shown to under-report negative thoughts for fear of being regarded as unfit mothers or labelled as 'mentally ill' (McIntosh, 1993). Moreover, mothers with recognized psychiatric disorders, who demonstrate greater limitations in mentalization and executive functioning abilities, might display the predicted associations between these abilities and bonding.

Despite the variations in mood of our sample, the majority of mothers experienced very mild anxiety and depression or no mood disturbance. Whilst a relationship between bonding and depression was established, maternal mood did not significantly influence mentalization ability, recognition of infant facial expressions and the majority of executive functioning tasks. Depressed mothers appeared to view the relationships to their infants as less favourable and, unsurprisingly, appeared to be more anxious. However, these symptoms did not generalize to mentalization or executive functioning abilities, with the exception of increasing the error scaled score on the Hayling and thereby showing a tendency to decrease the overall performance on the Hayling. The Hayling test might be more sensitive in detecting variations in response latency influenced by possibly slowed reaction or processing times brought on by depressive symptoms. The finding that mothers with younger infants tended to show higher levels of depression might be related to sleep deprivation or normal adjustment following a significant life-event. This was investigated further and supported by the finding that there was a significant negative correlation found between item 16 ('changes in sleeping pattern') on the BDI-II and infant age.

The variations of scores on all measures was limited by the use of a non-clinical sample and future research may wish to consider utilizing a group of mothers with psychiatric disorders in order to obtain more diversity in both parenting abilities and cognitive functioning. However, the current study set out to explore mentalization ability, executive functioning, infant facial recognition and bonding in a community sample of mothers. Furthermore, the sample size was reasonable and the measures employed had good psychometric properties. The fact that maternal mentalization ability and executive functioning were not associated with the mother's perceptions of bonding to her infant in this study suggests these factors are unrelated (cf. Bach *et al.*, 2000), although this finding should be considered in the context of other research that has identified an association between mentalization and executive functioning (e.g. Russell, 1997). It is important to explore these relationships further in more diverse samples that include mothers with bonding difficulties. Similarly, although the results of the current study do not have direct clinical applicability, current parenting assessment methods in the UK mean that those within the general population who experience fewer ostensible difficulties will not be provided with additional support until these difficulties reach a critical point, following which professional concerns are raised regarding neglect or abuse. Given the conservative interpretation of the current findings, future studies might usefully develop more sensitive assessments of mothers' ability to recognize infant distress or facial expressions and of their mentalization abilities, which might have utility in the early detection of potential difficulties in the mother-infant relationship.

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