Maternal stress and depression and the lateralisation of infant cradling

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Background: Studies show that 65–85% of mothers cradle their infants to the left side of their body, but that this bias changes with maternal mood and stress. The present study examines the hypothesis that maternal stress and depression status will influence the cradling bias differentially. Method: As part of a larger study on mother–infant interaction, mothers (N = 79) were asked to pick up and briefly hold their children in their arms (44 boys, 35 girls; mean age 7.2 months, range 3 to 14 months). Results: Results indicated that 86% of mothers who were neither stressed nor depressed cradled to the left and 14% to the right. Comparing the cradling side of stressed mothers with those who were neither stressed nor depressed, more in the former group showed right-sided cradling. In contrast, mothers who were just depressed preferred to cradle to the left. Conclusion: The lack of a left-sided cradling bias might be due to stress rather than depression experienced by mothers. Furthermore, this study provides evidence that the state of maternal mental health might be indicated by the side on which they cradle their child preferentially. Keywords: Lateralisation of holding infants, maternal depression, maternal stress, parent–child interaction. Abbreviations: EPDS: Edinburgh Postnatal Depression Scale; PSI/SF: Parental Stress Index/Short Form.

Most mothers demonstrate a leftward cradling bias when carrying their infants. Estimates of a left-sided cradling bias vary from 65 to 85%. Such a bias has been consistently shown to be unrelated to hand preference (e.g., de Chateau, Holmberg, & Winberg, 1978; de Chateau, 1987; Salk, 1960; Turnbull & Lucas, 1996; Bourne & Todd, 2004; Harris, Almerigi, Carbary, & Fogel, 2001; Manning & Chamberlain, 1990; Reissland, 2000; Vauclair & Donnot, 2005; Vauclair & Scola, in press). In contrast, a recent study observed participants ranging from 4 to 86 years of age during ‘functional cradling’, namely, cradling a doll while giving it a pacifier with the free hand (van der Meer & Husby, 2006). In this study, participants cradled more often with their non-dominant arm. Nevertheless, in most studies reported in the literature, cradling or holding an infant, either imagined or real, results in a leftward bias. Hence, given that both left- and right-handed mothers tend to have a left-sided bias when the sole purpose of cradling is holding the child, one favoured explanation of the leftward cradling bias has centred on the potential it offers for mothers to monitor the emotional expressions of their infants.

If emotions affect cradling side, then one might expect that child and maternal emotional states will influence the cradling side. Manning et al. (1997), for example, argue that the flow of affective information from the left ear and eye to the cradler’s right hemisphere, where emotional encoding is predominantly considered to take place, is facilitated by leftward cradling. It should be noted, however, that decus-
Jasnow, 2001), one would expect that maternal depression would affect cradling preference.

The hypothesis that maternal depression might lead to a reduced leftward cradling preference was tested in a recent study in which depressed and non-depressed mothers were observed while holding their children during the ‘Strange’ situation (Weatherill et al., 2004). Maternal depression was measured by means of the Beck Depression Inventory (Beck, 2002). The Strange situation is a procedure in which mother and child interact in a series of eight episodes designed to be increasingly stressful for the child (Ainsworth, Blehar, Waters, & Wall, 1978). Given that stress responses of children are matched by their mothers’ stress response as measured, for example, by salivary cortisol samples (e.g., Sethre-Hofstad, Stansbury, & Rice, 2002), the procedure will elicit stress not only in the child but also in the mother. Weatherill et al. (2004) reported that mothers in the non-depressed group showed a significant left cradling preference (i.e., significantly different from ‘no bias’), which was not the case for the depressed group.

In summary, in Weatherill et al.’s (2004) study, the cradling bias was observed during exposure to a stressful situation in mothers who were either depressed or non-depressed. It is not clear whether the lack of a cradling bias relates to maternal depression or maternal stress or both, and therefore it is unclear whether maternal stress or maternal depression on its own is associated with a particular cradling bias or the lack of one. A study by Bogren (1984) suggests that there might be an association between stress and a cradling bias. Anxiety and stress are related in that anxiety is the normal reaction to stress (Boudarene, Legros, & Timsit-Berthier, 2002; Ehrlert, 2006). Thus, Bogren’s findings that mothers who were anxious about their pregnancy had a propensity for cradling to the right indicates that maternal stress might lead to a rightward cradling bias.

In the present study, given that anxiety is the normal reaction to stress, it would be expected that mothers who are stressed at the time of the study will show a right-sided bias. Additionally, following the findings of Weatherill et al. (2004), we would expect that mothers who are depressed show a reduced leftward cradling bias. Although studies have considered the roles of either maternal anxiety/stress or depression on the cradling bias, none have examined both maternal stress and depression in relation to this bias. The present study asks if the propensity to hold infants on the left side of the body is affected by maternal depression or stress, and whether depression and stress have an additive effect in that mothers who are both stressed and depressed show a more significant right-sided bias or at least a reduced leftward bias while mothers who are neither stressed nor depressed have a significant left bias.

Method

Participants

Seventy-nine mothers (mean age 31.8 years, range 20–42 years) and their full-term infants (44 boys and 35 girls; mean age 7.2 months, range 3 to 14 months) were recruited from the birth register of the Aberdeen Maternity Hospital. All mothers, with a mean 15.8 years of education (range 7–21 years), lived in the Grampian region, and were the primary caregivers. Thirty-seven mothers were primiparous and 42 were multiparous.

Mothers were contacted by post and asked to take part in a study on maternal postnatal depression after ethical approval had been obtained from the NHS Grampian Research Ethics Board. All parents taking part gave informed consent to participate in the study.

Procedure

Those mothers who consented to take part in the study completed the Edinburgh Postnatal Depression Scale (EPDS; Cox, Holden, & Sagovsky, 1987), and the Parental Stress Index/Short Form (PSI/SF; Abidin, 1995). According to Abidin (1995), the PSI is a measure designed to examine the parent–child system under stress and at risk for dysfunctional parenting behaviour. It has been widely used to examine stress rather than depression in parenting (e.g., Tan & Rey, 2005). The PSI/SF includes sub-scales measuring personal parental distress, parent–child interaction, and a child’s behavioural characteristics as perceived by the mother. A total level of parenting stress is obtained by adding the scores of the sub-scales (Abidin, 1995). Abdin divided his total scores into those falling within the normal range (the 20th to 80th percentile) and those below (e.g., when mothers show low vigilance or are very defensive, dishonest or disengaged; Thomas, Reynaud, & DePaul, 2004) or above it. Accordingly, mothers were classified as stressed if they fell below the 20th and above the 80th percentile.

Total scores on the EPDS range from 0 to 30, with a score of 9 or above identifying a depressed mood (Cox, Murray, & Chapman, 1993; Cox & Holden, 1994; Peindl, Wisner, & Hanusa, 2004; Dennis, 2004; Henshaw, Foreman, & Cox, 2004). A score of 9 has been identified as an ideal cut-off point using ROC curves to identify postnatal depression (e.g., Lee et al., 1998; Lee, Yip, Chiu, Leung, & Chung, 2001). On this basis, 19 mothers were classified as showing postnatally depressed mood (mean = 11.94, range 9–19) and 60 as not (mean = 4.33, range 0–8). Since the infants were all above 1 month old, the period during which mothers might be suffering from postnatal ‘blues’ was excluded as by definition such an outcome lasts less than 1 month after the birth of a child (Steiner, 1998). Based on both the PSI/SF and EPDS scores, mothers were coded as either stressed (N = 44) or not stressed (N = 35), with 13 mothers being both stressed and showing depressed mood.

Mothers were asked once to pick up their children and cradle them in their arm since spontaneous holding is a good indicator of cradling bias. Vaucclair and Donnot (2005) found no difference in cradling side
depending on whether participants are given the choice between right and left cradling after having cradled on either side or whether their spontaneous first cradling preference is observed.

Following others (e.g., Bogren, 1984; de Chateau, Maki, & Nyberg, 1982), cradling was simply defined as ‘holding the infant’ and cradling side as the side of the mother’s body on which the infant’s head was positioned. During performance of the task, 65 mothers remained seated while 14 stood up. The mean ages of infants cradled to left and right were 7.6 months (range 3–14 months) and 8.2 months (range 4–18 months), respectively. Approximately nine months after the data on cradling side had been collected, 54 of the original sample of 79 mothers were successfully contacted and asked to answer by phone 10 questions of the Edinburgh Handedness Inventory (Oldfield, 1971), as well as two questions on ear preference (listening on telephone; listening to a conversation behind a closed door) and two on eye preference (peeping through a keyhole; tilting the head to right or left). We did not establish hand or other preferences of participants during the study. This had the advantage of not introducing any covert bias into the evaluation of cradling preference. It had, however, the disadvantage that although we were able to get information on the bias for the majority of participants, a few of them could not be contacted. The short version of the inventory consists of 10 questions concerning the left hand (coded as 0), both hands (coded as 1) or right hand (coded as 2), with the resultant scores being 20 for a completely right-handed person and 4 or less indicating very left-handed. For the majority of the sample of 79 mothers were successfully contacted and asked to answer by phone 10 questions of the Edinburgh Hess Handedness Inventory (Oldfield, 1971), as well as two questions on ear preference (listening on telephone; listening to a conversation behind a closed door) and two on eye preference (peeping through a keyhole; tilting the head to right or left). We did not establish hand or other preferences of participants during the study. This had the advantage of not introducing any covert bias into the evaluation of cradling preference. It had, however, the disadvantage that although we were able to get information on the bias for the majority of participants, a few of them could not be contacted. The short version of the inventory consists of 10 questions concerning the left hand (coded as 0), both hands (coded as 1) or right hand (coded as 2), with the resultant scores being 20 for a completely right-handed person and 4 or less indicating very left-handed. For the study, a score of 9 and below was considered to represent left handedness and a score of 10 and above to represent a right-hand preference.

All interactions, including playing with a soft toy and a Jack-in-the-box, between mother and her child were videotaped, but only cradling was analysed for the purpose of the present paper. An independent observer, who was blind to the questions that motivated the study, judged the cradling side of 12 mothers (15% of the sample). There was 100% agreement between this observer and the original coder of the videotapes.

**Results**

Cradling side was unrelated to age of child ($t = -1.4$, df = 77, $p = .162$). Furthermore, there was no relation between age of child and whether the mother was seated ($N = 65$) or standing ($N = 14$) during cradling ($t = - .77$, df = 77, $p = .44$). Cradling side was also unrelated to whether the mother was primiparous or multiparous ($t = 1.36$, df = 77, $p = .177$). Based on the handedness inventory, 52 mothers were right-handed and 2 were left-handed, while 15 mothers preferred their left ear and 19 their right ear to listen on a telephone and to a conversation behind a closed door, with 20 using either ear. Moreover, 10 mothers peeped through a key-hole with the left eye and held their heads tilted to the left, 23 with the right eye, and 21 had no preference in these respects. The relationships between cradling side and handedness ($t = - .72$, df = 52, $p = .47$), eye ($t = - .60$, df = 52, $p = .54$) and ear preference ($t = - .92$, df = 52, $p = .35$) were all non-significant.

In order to identify whether maternal depression level was related to maternal stress level, we compared mothers who were stressed (mean EPDS = 4.29) and not stressed (mean EPDS = 4.3) with their depression score on the EPDS, an outcome that was not significant ($t = 1.34$, df = 77, $p = .81$). Hence, depression level as measured by the EPDS was not significantly related to whether mothers were stressed or not stressed based on the PSI.

Of the mothers who were stressed and depressed, 61% cradled to the left and 39% to the right, whereas for mothers who were neither stressed nor depressed, 86.2% cradled to the left and 13.8% to the right (see Table 1). The non-stressed and non-depressed group of mothers provided the baseline against which cradling preference was tested. When confronted with small sample sizes and/or requirements of the chi-square statistic were violated, exact probabilities were calculated.

We tested whether the proportion of either right or left cradlers who were only stressed, only depressed or both stressed and depressed differed significantly from the proportion of right and left cradlers in the sample of mothers who were neither stressed nor depressed. Mothers who were both stressed and depressed ($N = 13$) relative to mothers who were neither stressed nor depressed ($N = 29$) showed a significant right cradling bias ($\chi^2 = 6.46$, df = 1, $p = .02$). Significantly more mothers who were only stressed cradled to the right ($N = 10$) compared to those who were neither stressed nor depressed ($N = 4$; $\chi^2 = 7.83$, df = 1, $p = .008$). In contrast, there was no difference in cradling bias between the proportions of mothers who were only depressed ($N = 6$; $\chi^2 = .035$, df = 1, $p = 1.0$) relative to those who were neither depressed nor stressed.

<table>
<thead>
<tr>
<th>Stress and depression status</th>
<th>Cradling side</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Left</td>
<td>Right</td>
<td></td>
</tr>
<tr>
<td>Stressed and depressed</td>
<td>8</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Count</td>
<td>61</td>
<td>39</td>
<td></td>
</tr>
<tr>
<td>Mean EPDS score</td>
<td>13.2</td>
<td>11.4</td>
<td></td>
</tr>
<tr>
<td>Only stressed</td>
<td>21</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Count</td>
<td>68</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>Mean EPDS score</td>
<td>3.9</td>
<td>4.5</td>
<td></td>
</tr>
<tr>
<td>Only depressed</td>
<td>5</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Count</td>
<td>83</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Mean EPDS score</td>
<td>10.4</td>
<td>11.0</td>
<td></td>
</tr>
<tr>
<td>Neither stressed nor depressed</td>
<td>25</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Count</td>
<td>86</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Mean EPDS score</td>
<td>5.04</td>
<td>4.7</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Cradling side of mothers who were stressed and depressed, only stressed and only depressed, and neither stressed nor depressed

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Discussion

For mothers who were neither stressed nor depressed, the typical bias of 86% cradling to the left and 14% cradling to the right was evident in the present study. Spontaneous holding is a good indicator of cradling bias in that Vauclair and Donnot (2005) found no difference in cradling side depending on whether participants are given the choice between right and left cradling after having cradled on either side or whether their spontaneous first cradling preference is observed. Furthermore, there is a wide variation in the cradling bias irrespective of age of infant. In our study, the cradling side was unrelated to age of infant tested. Although some authors note (e.g., Weatherill et al., 2004) that the percentage of individual mothers who held their infants (11 to 18 months) on the left was lower compared to studies of newborns and young infants, others (e.g., Todd, 2002) reported that even mothers of 3-month-olds did not show a left-ward cradling bias. Furthermore, Vauclair and Scola (in press), studying 8-day-old infants, found that stress and depression, but not the age of the infant, have differential effects on cradling side.

The proportion of mothers who were stressed relative to non-stressed and non-depressed mothers displayed a significantly reduced left-sided cradling bias. Running counter to our expectation, most mothers who were only depressed, relative to the proportion of mothers in our sample who were neither stressed nor depressed, preferred to cradle their infants on the left. As found by Weatherill et al. (2004), mothers who were both stressed and depressed revealed a propensity to cradle on the right. However, in contrast to the findings of Weatherill et al., who claimed that mothers who were depressed showed a reduced left cradling bias, we found that depressed mothers (83%) had a clear-cut preference to cradle on the left.

One possible explanation for this difference could be that the Strange situation, in which cradling was observed by Weatherill et al. (2004), is not only increasingly stressful for the child, but also for depressed mothers, thus giving rise to a right-sided cradling tendency. This interpretation is supported to some extent by Weatherill et al. in their description of the situation. They write: The videotapes showed that, when holding a distressed child, mothers frequently shifted the child rapidly from side to side in an effort to soothe the child” (p. 426). Consequently, deviations from the leftward cradling bias might be due to varying stress levels experienced by mothers rather than variations in depression.

This supposition is supported by Salk (1960) who found a leftward cradling bias in 83% of mothers of newborns, but only for mothers who had normal pregnancies and deliveries and held their infants immediately after birth. Among mothers initially separated from their infants because of prematurity or illness, and who were presumably stressed, the figure declined to 52%. Given that mothers who cradle their infants to the right not only used higher pitch of voice compared to mothers cradling their child to the left and that the same mother changing cradling side also changed pitch of voice (Reissland, 2000), but also that this higher pitch is associated with more stress (e.g., Ladd, Silverman, Tolkmitt, Bergmans, & Scherer, 1985), it seems reasonable to conclude that mothers who cradle to the right use more stress in their vocalisations. Stressed vocalisations can be due to various factors. For example, Protopapas and Lieberman (1997), analysing naturally occurring speech during highly stressful and non-stressful conditions, found that mean fundamental frequency correlated highly with stress rating. On the other hand, Papoušek, Papoušek, and Symmes (1992) and others (Fernald, 1992; Reissland & Snow, 1996) found that mothers use a higher fundamental frequency when encouraging attention in their infants compared to when they were trying to soothe the infants. Hence, it is reasonable to conclude that maternal stress, be it positive (such as when they try to engage a child’s attention) or negative (when they feel stressed themselves) leads to a higher pitch of voice and that stress rather than depression leads to an increased right-ward cradling bias.

The focus of this study was whether the presence or absence of a clear-cut cradling bias might be indicative of maternal mental health. Clinical and research implications of findings that stress might be a precursor to depression suggest that increased brain serotonin may improve the ability to cope with stress and that a decline in serotonin activity is involved in depressive mood (Markus et al., 2000). It should be noted that in the present study mothers were not identified as clinically depressed. Rather, they were tested on the EPDS, which is a self-report scale identifying depressed mood in the postnatal period. Thus, given the extensive literature (e.g., Hay et al., 2001; Murray, Kempton, Woolgar, & Hooper, 1993; Patel, DeSouza, & Rodriguez, 2003; Reissland, Shepherd, & Herrera, 2002) showing that maternal depressed mood has long-term effects on child development, this study reveals the differential effect of stress and depression on maternal holding behaviour. In the same way that stress is a precursor of depression, maternal right-sided cradling might be indicative of later depression.

Support for the claim that stress and depression have differential effects on cradling preference is given by Vauclair and Scola (in press). They found that mothers of boys who were less than 3 kg at birth, and who the authors argue were anxious because of the comparatively light weight of the boys and associated worries about the health of their child, cradled to the right. However, it should be
noted that in the present study the proportion of depressed mothers was relatively small (22.7% of the sample) compared with that for stressed mothers (55.6% of the sample), and hence future studies should include groups of stressed and depressed mothers more equal in size.

Bourne and Todd (2004) reported that right-handed women with a leftward cradling bias had right-hemisphere dominance for the perception of facial emotions, whereas right-cradlers showed a trend towards left-hemisphere specialisation. Given that both left- and right-handed mothers tend to have a left-sided bias when they hold their child, it seems not only that the cradling bias is elicited because mothers might be able to monitor the emotional expressions of their infants, but also because the mother’s own emotional state influences which side they cradle on. However, this seems to be only the case when individuals cradle a child while playing with a soft toy with their free hand. In contrast, handedness seems to influence cradling side when participants, ranging in age between 4 and 86 years, are asked to use their free hand in order to complete an unrelated task while at the same time cradling a doll (van der Meer & Husby, 2006). This study found that adult participants cradled more often with their non-dominant arm if they were asked to cradle a doll while performing an action with their free hand. However, they were not tested for stress and depression, nor did they hold a live infant, which according to Donnot and Vauclair (2005) is an important part of identifying psychological effects on the infant holding bias. A future study should test whether the cradling bias might be changed depending on depression or stress of individuals or on additional tasks, unrelated to holding a child. Furthermore, it would be interesting to follow right-cradling mothers longitudinally and establish whether right cradling might be a predictor of maternal depressive mood.

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References


Vauclair, J., & Donnot, J. (2005). Infant holding biases and their relations to hemispheric specializations for...


Correction added after online publication on August 22 2007:


As authors of this paper, we would like to make a correction following feedback, post-online publication, regarding our use of statistics.

An independent expert, Brian Francis (Professor of Social Statistics, Lancaster University, UK) was asked to reanalyse the data. He agreed that a series of one-sample tests was not appropriate and suggested the following method as being appropriate.

We should fit a binomial logistic regression with two explanatory factors and summarise the results through an Analysis of Deviance table. Thus, instead of reporting sums of squares as in an ANOVA table, we use deviance (or minus twice the log likelihood). This allows us to investigate jointly two hypotheses: 1. Does the proportion of right-sided cradlers vary by stress level and by depression level?, and 2. Is there an interaction between the two factors?

We modelled the probability of right cradling \( p = \text{RIGHT}/(\text{LEFT}+\text{RIGHT}) \) through the logistic model: \( \log(p/(1-p)) = \logit(p) = \text{linear model} \).

We adopted a type-I approach; we first tested the interaction term and then removed it from the model if non-significant. Following the interaction test, we then tested and removed the next least significant factor, which in this case was the ‘depressed’ indicator. Finally, we tested the remaining term – the ‘stressed’ indicator. We compared changes in deviance to a chi-square distribution on the appropriate number of degrees of freedom (see Table below)

<table>
<thead>
<tr>
<th>Effect</th>
<th>Change in deviance</th>
<th>Change in df</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main effects</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stressed</td>
<td>4.222</td>
<td>1</td>
<td>.040</td>
</tr>
<tr>
<td>Depressed (controlling for Stressed)</td>
<td>0.186</td>
<td>1</td>
<td>.666</td>
</tr>
<tr>
<td>Interaction</td>
<td>0.001</td>
<td>1</td>
<td>.975</td>
</tr>
</tbody>
</table>

The table shows that the ‘stressed’ effect is significant \((p=.04)\). Contrary to what was originally reported, there is no evidence of an effect of depression or of an interaction between stressed and depressed. The probability of right side cradling depends on the stress experienced by the mother. Hence, our original hypothesis that we would expect mothers who are depressed to show a reduced leftward cradling bias is not supported. In contrast, our expectation with regard to stressed mothers was upheld.