

Is maternal depression related to side of infant holding?

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Studies show that 65–85% of mothers hold their infants on the left side of their own body and that this left-bias may be reduced or reversed when mothers have symptoms similar to depression or dysphoria (de Château, Holmberg, & Winberg, 1978). No studies, however, have used diagnostic criteria to assess the mother's psychological state. The current study examined the relationship between maternal report of depressive symptoms on the Beck Depression Inventory and holding-side bias in a high-risk sample of 177 mothers participating with their infants in a larger longitudinal study of mother–infant relationships and domestic violence. Mothers classified as nondepressed showed a significant *left*-bias; those classified as depressed showed a nonsignificant *right*-bias; mothers who reported experiencing domestic violence also showed a reduced left-bias. The results are interpreted in terms of current theory and research on lateralised hemispheric activation and depression.

Introduction

For human beings and, indeed, for all primates, the parent–infant relationship is a complex behavioural system that has evolved to enhance the infant's physical survival, well-being, and healthy psychological development. An important part of this relationship is expressed through holding the infant, an act that serves many roles, including transportation, feeding and physical care, calming the infant when it is upset, and arousing and engaging it socially (e.g., Rheingold & Keene, 1965). The act of holding the infant has drawn the attention of researchers who study laterality of function because 65–85% of mothers, as well as women generally, hold the infant on the left side of their own body (e.g., de Château et al., 1978; Harris, 1997; Matheson & Turnbull, 1998; Salk, 1960). This bias occurs not only when actual infants are held but when the act is only imagined (e.g., Bogren, 1984; Harris, Almerigi, & Kirsch, 2000; Weiland & Sperber, 1970) and when dolls are held instead of infants (e.g., Bundy, 1979; Manning & Chamberlain, 1991, Exp. 1). The bias, however, is absent for holding books (e.g., Hanaway & Burghardt, 1976), bags of groceries (Rheingold & Keene, 1965), and other objects (Almerigi, Carbary, & Harris, 2002a). Together, the evidence suggests that for the bias to occur, the thing-to-be-held must have certain physical and psychological qualities. Although we cannot yet specify these qualities, they seem to include characteristics to which adults respond socially and emotionally—qualities not unique to, but perhaps best represented in, human infants.

Circumstances when the bias is reduced, absent, or reversed

The 65–85% left-bias figure pertains to infants under 1 year of age, with newborns and young infants (under 3 months) typically at the high end (Dagenbach, Harris, & Fitzgerald, 1988). After that, it declines until, by the time the child is 2 to 3 years old, it is replaced by a right-side bias (e.g., Lockard, Daley, & Gunderson, 1979). Even in young infants, the bias also is weaker or even reversed in certain circumstances associated with dysphoria or other negative affect in the holder, for example, in women separated from their infants because of prematurity or illness (de Château et al., 1978; Salk, 1970). Consistent with these findings, a study of primiparous women tested 1 week after delivery found that more left holders (72%) than right holders (58%) reported feelings of affinity with their infant (de Château, Maki, & Nyberg, 1982). In an interview 1 month before delivery, left-side holders also reported making more preparations for the delivery and experiencing fewer negative perceptions of their body image. The authors concluded that right-holding might be associated with a reduced willingness or ability to become emotionally involved with the infant.

Explanations of the bias

The reasons for the bias in normal circumstances, as well as its reduction or reversal in special circumstances, have not been fully explained. For example, it does not seem to be merely for

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the purpose of leaving the right, normally dominant, hand free because left-handers, although usually in smaller proportions than right-handers, also hold preferentially on the left, or at least do not show a reverse bias (e.g., Harris et al., 2000; Salk, 1962; but see Almerigi et al., 2002a). It is possible that left-handers hold on the left for different reasons than right-handers or that, in their choice of holding side, left-handers are influenced by living in a predominantly right-handed world. Salk (1960, 1961) proposed that the bias was caused not by handedness but by the sound and feel of the maternal heartbeat, which, being stronger on the left, makes the left-hold more comforting for the infant. This explanation is open to question if only because it would seem to necessitate experience with infants. It also is difficult to test for the obvious reason that it would require a control group of mothers with hearts on the right side (Todd & Butterworth, 1998; see also Turnbull & Lucas, 2000).

Another explanation links the bias to the leftward direction of the holder's attention. This explanation assumes that either the act of perceiving a face or those infant characteristics to which the holder responds emotionally (e.g., the infant's vocalisations, cries, and facial expressions) selectively activate neural systems in the holder's right hemisphere, driving attention to the left. It further suggests that this same state of activation is adaptive in that it enhances the holder's ability to interpret and monitor the infant's emotional state. So far, one or another form of this hypothesis has found at best only weak support from visual tests (e.g., Harris, Almerigi, Carbary, & Fogel, 2001; Turnbull & Lucas, 1996), and mixed support from auditory tests. The latter have compared left- and right-side holders' recognition of the emotional tone of dichotically presented speech. Tests using sentences found no differences (Sieratzki, Roy, & Woll, 2002; Turnbull, 2002; Turnbull & Bryson, 2001). A test using words gave more promising results, finding that only left-side holders showed a significant left-ear (right-hemisphere) advantage and were more accurate overall (Almerigi, Van Hooren, Bulman-Fleming, & Harris, 2002b).

The possibility that a reduction or reversal in holding-side bias is associated with negative maternal affect remains in question inasmuch as no studies of holding have diagnosed maternal emotional state, making it difficult to know the specific affect being assessed, such as depression and anxiety. That affect, especially depression, might play a role, however, is compatible with evidence relating depression to reduced right (relative to left) posterior hemispheric activation as reflected in performance on neuropsychological tests of attention (Banich, Stolar, Heller, & Goldman, 1992; Bruder, Quitkin, Stewart, Martin, Voglmaier, & Harrison, 1989; Heller, Etienne, & Miller, 1995). Based on the attentional hypothesis, this would suggest that, for depression, the leftward attention underlying the modal left-side holding bias is attenuated, either because infant characteristics have different psychological effects in depressed and nondepressed individuals, or because the effects are insufficient to overcome a hypoaroused right posterior hemisphere (Harris, 1997). In either case, studies have found that depressed mothers spend less time looking at and touching their infants, are less responsive to them (Cohn, Campbell, Matias, & Hopkins, 1990; Field, 1984, 1995), and are more likely to show withdrawn behaviour with their preschool children (Dawson et al., 2003), which would be consistent with evidence suggesting that a reduction or reversal of the left-side holding

bias is associated with disturbances in the mother-infant relationship.

The current study examined whether maternal depression, as indicated by the number of symptoms reported on the Beck Depression Inventory (BDI), was related to side-of-holding in a sample of 177 mothers and their infants participating in a larger study on the effects of domestic violence on mother-infant relationships. Approximately half the mothers had experienced domestic violence with their partners at the time of recruitment; the other half had not. Because the experience of domestic violence is associated with an increased likelihood of depression (Campbell & Lewandowski, 1997), we expected the sample to provide an adequate number of depressed women to test the hypothesis.

Relative to the overall left-side bias that we expected to find in the sample as a whole, we predicted that the reporting of depressive symptoms would be associated with bias reduction or reversal. Given the association of domestic violence with depression (Campbell & Lewandowski, 1997), we also predicted bias reduction or reversal for the subgroup of women reporting domestic violence.

Method

Research participants

The larger study consisted of 206 women recruited and initially interviewed during pregnancy. The 177 women in the current study were those who participated in a second interview 1 year post-partum and who were videotaped with their infants in the *Strange Situation* procedure (Ainsworth, Blehar, Waters, & Wall, 1978). Of the larger sample, 17 women could not be located at the time of the 1-year interview, and 12 did not complete the procedure, either because they had lost custody of their infant ($n = 4$), had moved out of state ($n = 6$), or because of technical difficulties ($n = 2$). A t -test indicated that there was no significant difference between the depression scores of the 12 women who did not complete the Strange Situation procedure and those who did. The 12 women who did not complete the procedure, however, did have a significantly lower mean score on the domestic violence measure (indicating less domestic violence) than the women who completed the procedure, $t(127) = 2.51, p < .05; n = 12, M = 0.83 (SD = 2.04)$ vs. $n = 117, M = 3.66 (SD = 10.37)$, respectively. Participants were recruited by posting fliers in public areas and by obtaining referrals from hospitals and other programmes that provided financial, legal, and health services to pregnant women or victims of domestic violence in mid-Michigan. Criteria for participation included being between the ages of 18 and 40 and having a romantic relationship that lasted at least 6 weeks during pregnancy. Participants' mean age was 26 years (range: 19–41 years); their infants' mean age was 12.6 months (range: 11–18 months; 93% were between 11–14 months). Table 1 presents a demographic description of the sample.

Measures

Holding. Side-of-hold bias was determined by coding observations of a videotape of the Strange Situation. In this procedure, a mother and child interact in a series of eight episodes that alternate between those designed to be stressful

Table 1
Demographic characteristics of participants (N = 177)

<i>Characteristics</i>	
Racial/ethnic group	
Caucasian	62%
African American	25%
Latina	5%
Other	8%
Marital status	
Single, never married	43%
Married	45%
Separated, divorced or widowed	12%
Educational status	
Grades 7-12	37%
Trade school / some college / associate's degree	46%
Bachelor's / graduate degree	17%
Mean age of mother	26 yrs
Range	19-41 yrs
SD	5 yrs
Mean age of infants	12.6 m
Range	11-18 m
SD	1 m
Mean weight of infants	22.6 lbs
Range	16-35 lbs
SD	3 lbs

for the child, e.g., when the mother leaves and a stranger enters, and those in which the mother returns and is available to provide comfort to the child. Mothers were instructed when to leave and return, but no instructions or comments were made about holding their child; they were simply told to respond to their child as they would naturally. Holds were coded for side of hold, mother's position (e.g., seated, standing), type of hold (e.g., shoulder, arm, or lap hold), and purpose of hold (e.g., transport, comfort). In addition, whether or not the child was distressed (crying) at time of hold and duration of hold in seconds were also recorded.

Handedness. Handedness was assessed by self-report (participants were asked whether they were right- or left-handed). This information on handedness was not initially collected during the 1-year interview but was obtained at a subsequent interview. Handedness was assessed for all but 11 participants who were unable to be reached at the follow-up interview.¹

Depression. Depression was assessed with the Beck Depression Inventory (BDI; Beck, Ward, Mendelson, Mock, & Erbaugh, 1961), a 21-item self-report measure that asks about symptoms and attitudes that describe specific behavioural manifestations of depression (e.g., depressed mood, pessimism, sleep disturbances, and changes in appetite). For each item, participants choose one of four descriptive statements that best describes how they have been feeling during the past week. The statements are ranked from neutral (0) to severe (3). Total scores can range from 0-63: in the current sample, scores ranged from 0-29, with a mean score for all mothers ($n = 177$) = 5.7. For the purpose of this study, participants who scored

above 12 were classified as depressed; those scoring 12 or below were classified as nondepressed. A cut-off of 12 was chosen because it is considered indicative of mild to moderate depression (Beck et al., 1961) and has been used in previous research on maternal depression (Field, 1984). A BDI score of 12 does not in itself warrant a diagnosis of clinical depression, but, for our purposes, was considered an adequate basis for differentiating greater and lesser experience of depressive symptoms. By these criteria, 19 (11%) of the 177 mothers were classified as depressed, 158 (89%) as nondepressed. Beck et al. (1961) reported that split-half reliability estimates yielded a coefficient of .93 after a Spearman-Brown correction, indicating high internal consistency. In the current study, the coefficient alpha was .85.

Domestic violence. The Severity of Violence Against Women Scales (SVAWS) (Marshall, 1992) is a 46-item self-report questionnaire that assesses violent behaviours and threats, including physical and sexual violence, that the woman may have experienced from her partner. Participants rate how often each item occurred on a scale ranging from *never* (1) to *many times* (4). Individual scores were calculated by summing the items. Women were asked to complete the scale for the year prior to the interview, the first year after the child's birth.

For the purposes of this study, a woman was categorised as battered if she checked any item in the following categories: threats of serious violence, mild violence, minor violence, moderate violence, serious violence, and sexual violence. Examples include "threatened to hurt you," "choked you," and "used a knife or a gun on you." By this criterion, 44 mothers (25%) were categorised as battered (range: 1-73; $M = 12$; $SD = 14.8$). In the current study, the coefficient alpha was .95.

Procedure

Graduate and undergraduate research assistants were trained to administer the questionnaires and to conduct and videotape the Strange Situation procedure. Interviews were held at the project offices and lasted approximately 3 hours. The women were given cash compensation for their participation.

Videotapes of the Strange Situation procedure were reviewed by a different set of three graduate and two undergraduate research assistants, with holds coded as described above. Coders worked in pairs, observing the tapes and making decisions about the codes for each hold together. Another coder reviewed the tapes and checked the codes for approximately half of the sample. Reliability for side of hold, mother's position, type of hold, and purpose of hold was calculated on independent double coding of 5% of the sample by computing percentage agreement: inter-rater agreement was 100% for these codes.

Results

Calculation of bias

All types of holds were combined for bias calculations. Each hold was scored as left (+1), middle (0), or right (-1). Two holding bias scores were calculated for each mother. First, a bias score based on the number of holds on the right vs. left

¹ Handedness may be more thoroughly assessed using a standardised handedness questionnaire; however, because the data were collected within the time limits of an interview for a larger study, it was not possible to administer such a questionnaire. For the purpose of this study, it is felt that the self-report information is an adequate indicator of handedness.

Table 2
Holding bias classification ($N = 161$)

Holding bias	Left-side bias	No bias	Right-side bias
Based on no. of holds	92 (57.1%)	15 (9.4%)	54 (33.5%)
Based on time in s	99 (61.5%)	7 (4.3%)	55 (34.2%)

Sixteen (9%) of the 177 mothers had no observed holds.

side was obtained by averaging the right (-1) and left ($+1$) scores for each mother: This yielded individual bias scores ranging from $+1$ (all left-side holds) to -1 (all right-side holds). A second bias score based on the length of time holding on the right vs. left was calculated by subtracting the average time in seconds each individual spent holding on the right from average time on the left: As with the first bias score, negative scores indicate more right- than left-holding, and positive scores indicate more left- than right-holding. Separate analyses were conducted for each of the bias scores.

Holding bias

Of the 177 mothers in the sample, for 16 (9%), no holds were observed. For the 161 observed to hold at least once, the group as a whole showed a significant left-bias in analyses based on number of holds, $t(160) = 2.93, p < .01; M = 0.18 (SD = 0.79)$. Among those with observed holds, 92 (57%) individuals showed a left-bias based on number of holds, 54 (34%) a right-bias, and 15 (9%) no bias. The results were similar when bias was calculated by time (see Table 2).

Handedness was not related to side of bias. Both left- and right-handers showed a significant left-bias for number of holds and time on each side, and the mean bias scores for the two groups were not significantly different for either type of bias score (see Table 3).

The strength of the left-bias was not significantly correlated with the infant's age, sex, weight, or mobility (whether the infant could walk or crawl), or with the mother's age or parity (all $ps > .05$). The mean length of hold for all mothers was negatively correlated with infant age ($r = -.28, p < .01$) but was not correlated with infant weight.

Holding-side bias and depressive symptoms

As we predicted, the reporting of depressive symptoms was related to a reduction of the left-bias. We found a significant difference in mean holding side bias for number of holds between the nondepressed and the depressed groups, $t(159) = 2.21, p < .05; n = 147, M = 0.23 (SD = 0.78)$ vs. $n = 14, M =$

Table 3
Mother's handedness and holding bias

Holding bias	Mean (SD)		<i>t</i>	<i>p</i>
	Left-handers (<i>n</i> = 12)	Right-handers (<i>n</i> = 138)		
Based on no. of holds	0.47 (0.62)	0.13 (0.79)	0.839	.407
Based on time in s	18.30 (49.55)	7.79 (43.06)	1.85	.080

Positive values indicate a left-bias. Handedness data was missing for 11 subjects.

Table 4
Depression and holding bias

Holding bias	Mean (SD)		<i>t</i>	<i>p</i>
	Nondepressed (<i>BDI</i> ≤ 12) (<i>n</i> = 147)	Depressed (<i>BDI</i> > 12) (<i>n</i> = 14)		
Based on no. of holds	0.21 (0.77)	-0.25 (0.83)	2.12	.036
Based on time in s	35.53 (116)	-22.14 (113)	1.78	.070

Positive mean values indicate a left bias and negative values indicate a right bias.

$-0.26 (SD = 0.83)$, respectively. Mothers in the nondepressed group showed a significant left-bias (i.e., significantly different from 0, or no bias), $t(146) = 3.51, p < .001; M = 0.23, SD = 0.78$, while mothers in the depressed group showed a non-significant right-bias, $t(13) = -1.17, n.s.; M = -0.26 (SD = 0.83)$ (see Table 4 and Figures 1 and 2). The pattern held for the bias calculated by time on each side, but the difference was significant at the level of a trend only (see Table 4). A chi-square test also found that the 16 mothers not observed to hold even once were significantly more likely to be classified as depressed than were the 161 mothers in the "holding" group, $\chi^2(1, N = 177) = 7.23, p < .05$; of the non-holders, 30% ($n = 5$) were depressed, vs. 9% ($n = 14$) of holders.

Holding-side bias and domestic violence

Consistent with our prediction, when depression was analysed on a continuous scale women in the battered group reported more depressive symptoms than those who were not battered, $t(175) = -1.98, p < .05; n = 44, M = 7.11 (SD = 5.0)$ vs. $n = 133, M = 5.23 (SD = 5.58)$, respectively. However, the battered and depressed categories did not significantly overlap. Women reporting violence were not more likely to be classified as depressed than women not reporting violence, $\chi^2(1, N = 177) = 0.024, p = .535$ (see Table 5).

Consistent with our prediction, and similar to the pattern shown in the nondepressed and depressed groups, women who did not report domestic violence showed a significant left-bias, $t(119) = 3.9, p < .001; n = 120, M = 0.27 (SD = 0.77)$, and the group reporting domestic violence showed a reduced bias that was not significantly different from zero (no bias), $t(40) = -0.599, n.s.; n = 41, M = 0.07 (SD = 0.83)$, when bias was calculated based on number of holds. The mean bias scores for the two groups were significantly different from each other, $t(159) = 2.48, p < .05$. The results were similar when bias was calculated based on holding time in seconds. Women who did not report domestic violence held for more time on the left whereas those who did report domestic violence held more on the right, $t(159) = 3.5, p < .005; n = 120, M = 16.26 (SD = 41.36)$ vs. $n = 41, M = -10.10 (SD = 42.06)$.

Table 5
Overlap between depressed and battered groups

	Not battered	Battered
Not depressed	119 (89%)	39 (89%)
Depressed	14 (11%)	5 (11%)

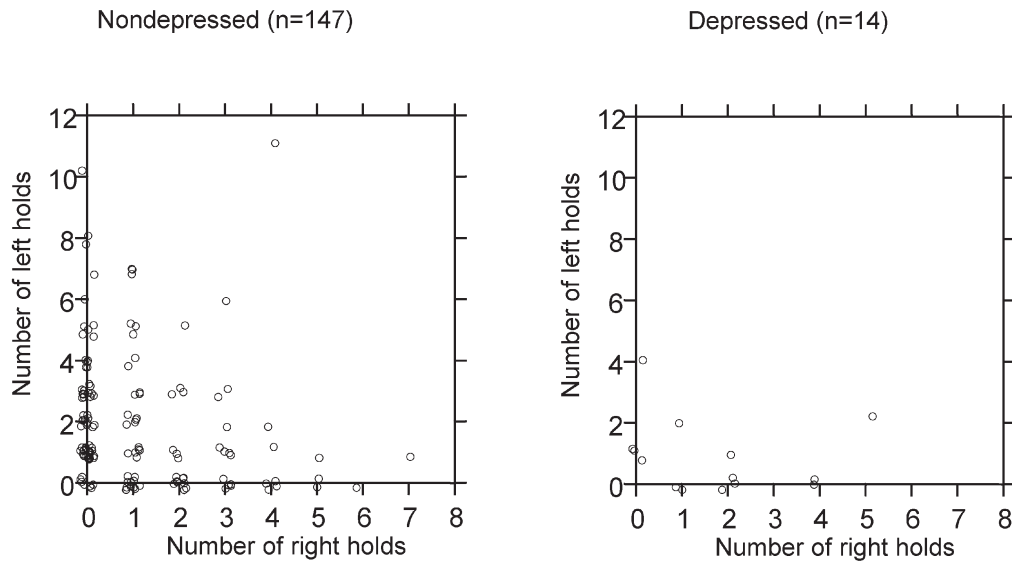


Figure 1. Number of left and right holds per individual for the nondepressed group (Beck Depression Inventory scores less than or equal to 12) and the depressed group (BDI scores greater than 12). The data points have been “jittered,” or randomly shifted, so that the overlap of individuals at any one point on the grid is apparent.

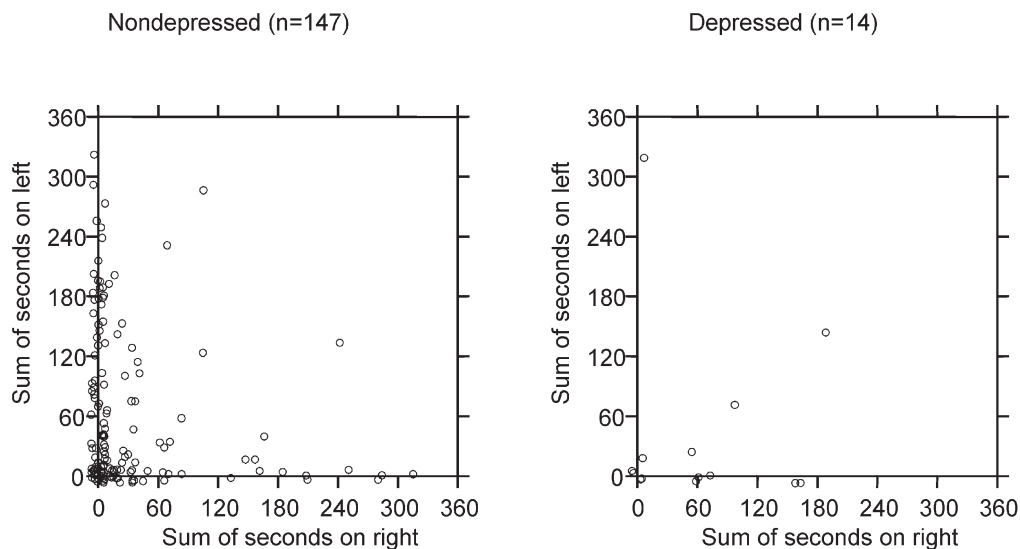


Figure 2. Sum of seconds for right and left holds per individual in the nondepressed and depressed groups.

Discussion

For the 161 women who held at least once, the group as a whole showed a left-bias, which was significantly reduced for the subgroup categorised as depressed. The bias also was reduced in the subgroup reporting domestic violence, perhaps because these women also reported experiencing more depressive symptomatology. Previously we cited reports that depressed mothers spend less time looking at and touching their infants and are less responsive to them (Field, 1984, 1992). The reduction in the left-bias may be another reflection of a disruption in the caregiving relationship. This possibility is consistent with de Chateau et al.’s (1982) conclusion, noted earlier, that right-side holding might be associated with a reduced willingness to become emotionally involved with the infant. We also previously noted evidence associating depres-

sion to a reduced right (relative to left) posterior hemispheric activation as reflected in performance on neuropsychological tests of attention. Given this evidence, along with the current results, it is possible that in depressed individuals, the infant’s cries do not cause the same arousal or leftward attentional shift, leading to a reduced left-side bias.

Although the mothers as a group showed a left-bias for this sample of 11- to 18-month-old infants, only 57–62% of individual women showed the bias (depending upon whether it was calculated by time or number of holds), a lower percentage than that found in mothers of newborns and younger infants. This is consistent with reports that the bias diminishes with age (Dagenbach et al., 1988). Within the sample, however, infant age was not related to side of hold, perhaps due to a restriction of range (11-18 months). Nor was infant weight related to side of hold.

Some limitations of the current study and directions for further research

The current study has several limitations. Classification of the participants as depressed or nondepressed was based on the number of symptoms reported on the BDI rather than by a diagnosis or history of diagnosis of clinical depression. The number of women endorsing symptoms of depression was small, and BDI scores were generally below the cutoff used for severe depression (Kendall, Hollon, Beck, Hammen, & Ingram, 1987). To further test the relationship between depression and side of hold, it may be important to use a larger sample of women who meet criteria for clinical depression on more than one measure. Another limitation pertains to the coding of holds. 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. In this study, we scored each shift as a separate hold, however brief, and combined the total amount of time for all holds to obtain a holding side bias. For future studies it may be useful to determine whether a series of brief, shifting holds represents one hold, which can be coded as primarily right or left, and then to compare holds of similar length or type, for example, comfort or transport, to determine whether the influence of affect is stronger in one type than another. Finally, many factors probably contribute to the side on which one holds a child in any given situation. For example, the mother might hold a child to let it see a toy or picture, she might shift the child so that she can reach for something, or the child might initiate the change by moving or twisting in the mother's arms. For this preliminary test of the role of depression in holding, it was not possible to consider all these factors. Future studies should examine their possible influence and how they might moderate the role of affect in side-of-hold.

The current study is a first step toward a better understanding of the nature of the affective states associated with the modal left-bias and with its reduction. We want to emphasize that we are not proposing that right-side holding in and of itself should or can be interpreted as a measure of depression: as we stated, many factors probably contribute to side-of-hold, and this study should be considered as only a preliminary contribution to understanding one of the emotional components. Future studies of holding could examine the possible long-term effects of affective states (e.g., depression) during the pre- or perinatal period on the developing mother-infant relationship. It may also be useful to directly test the attentional hypothesis by assessing and comparing the relationship between an independent measure of attentional bias and holding-side bias in depressed and nondepressed individuals.

We have been concerned so far only with mothers and their infants. The role of emotional state in the developing father-infant relationship also deserves careful attention. Fathers and men generally also show a left-bias for holding infants, which sometimes, especially for fathers of newborns, is as strong as the bias shown by women, and sometimes is weaker or even reversed (Dagenbach et al., 1988; Lockard et al., 1979). The study of fathers also is indicated in light of evidence of a reduced left-bias in fathers who, during their wives' pregnancies, were diagnosed with *Couvade syndrome*, a disorder whose symptoms include depression and dysphoria (Bogren, 1985). Finally, although the left-side bias has been documented in different cultures (e.g., Harris, Almerigi, & Kang, 2003; Lockard et al., 1979), there is also evidence for cultural

variations in adult behaviour toward infants, for example, in the frequency and closeness of holding and other means of physical contact (see Fogel, 2001, for a review). We shall be interested to know whether the relationship we found between affective state and side of hold will be replicated in different cultures.

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