Original Article

Evolutionary Psychology
April-June 2019: 1–12

DOI: 10.1177/1474704919848117
journals.sagepub.com/home/evp
SAGE

The Relationship Between the Left-Cradling Bias and Attachment to Parents and Partner

Gianluca Malatesta[1], Daniele Marzoli[1], Chiara Piccioni[1], and Luca Tommasi[1]

Abstract

Mothers usually cradle their infants to the left of their body midline, an asymmetry that seems to be a typically female lateral preference. This bias is deemed to be an evolutionary facilitator of communication between cradling and cradled individuals and is believed to be strongly related to hemispheric specialization for complex socio-affective behaviors. Thus, left cradling might facilitate affective interactions in females with typical brain organization, probably due to a right-hemisphere dominance for social attachment. In this study, we investigated cradling-side preferences in 288 young females as a function of their attachment styles to parents and partners. A left-cradling bias was more frequent in participants experiencing positive relationships with their mother and romantic partners. These findings indicate that the left-cradling bias may be associated with high-quality social attachment behaviors in females and, therefore, can be considered as a natural index of socio-emotional attunement between the cradling and cradled individuals.

Keywords

behavioral bias, hemispheric dominance, attachment styles, mother–infant relationship, social cognition.

Date received: September 3, 2018; Accepted: April 11, 2019

Approximately 90% of adults use the right hand preferentially for skilled acts; the other 10% prefer the left hand (McManus, 2004; Vallortigara & Rogers, 2005). A notable exception occurs when babies are held: 60–90% of adults, women especially, hold on the left of their own body midline, with the weight almost always on the left arm (Donnot & Vauclair, 2005; see Figure 1). This side bias appears regardless of ethnicity and historical period (as shown in paintings and sculptures in the history of the visual arts; Harris, 2010; Salk, 1973). It has been repeatedly shown that such a bias is a typically female lateral preference, having been observed not only in mothers but also in nulliparous women and young girls (Donnot & Vauclair, 2005; Forrester, Davis, Mareschal, Malatesta, & Todd, 2018) and also with dolls instead of real infants (de Château & Andersson, 1976; Forrester et al., 2018).

Lockard, Daley and Gunderson (1979) first suggested that cradling on the left side could help mothers in the appraisal of the emotional state of infants. In particular, mothers might take advantage of the more direct projections to their right hemisphere, which is specialized for recognizing emotional facial expressions (Borod et al., 1998; Gainotti, 2012; Prete, Capotosto, Zappasodi, & Tommasi, 2018). On the contrary, the reversal of the typical lateral cradling pattern seems to be associated with depression, stress, and anxiety in mothers (de Château, Holmberg, & Winberg, 1978; Morgan, Hunt, Sieratzki, Woll, & Tomlinson, 2018; Reissland, Hopkins, Helms, & Williams, 2009; Suter, Huggenberger, Blumenthal, & Schachinger, 2011; Suter, Huggenberger, & Schächinger, 2007; Weatherill et al., 2004).

Manning and Chamberlain (1991) tested the hypothesis that left cradling might facilitate the interpretation of infant's emotional state by observing interactions with dolls and infants in cradlers with the left or right eye covered, and found that

[1] Department of Psychological, Health and Territorial Sciences, University "G. d'Annunzio" of Chieti–Pescara, Chieti, Italy

Corresponding Author:
Gianluca Malatesta and Daniele Marzoli, Department of Psychological, Health and Territorial Sciences, University "G. d'Annunzio" of Chieti–Pescara, Blocco A Psicologia, Via dei Vestini, 31, I-66100, Chieti, Italy.
Emails: gianluca.malatesta@unich.it; d.marzoli@unich.it

Figure 1. Graphic representation of left-cradling behavior.

covering the left but not the right eye reduced the left-side preference. Therefore, from the mother's point of view, the left cradling would facilitate the monitoring of her infant's well-being through her left visual and auditory fields (Manning & Chamberlain, 1991; Sieratzki & Woll, 2002) by capitalizing on the right hemisphere specialization for emotional facial expressions (Borod et al., 1998; Gainotti, 2012; Prete et al., 2018), and in particular for faces expressing a subset of negative emotions (i.e., anger, fear and sadness; Najt, Bayer, & Hausmann, 2013) and for faces of crying infants (Best, Womer, & Queen, 1994). From the infant's point of view, the left cradling allows to get the best emotional information through a constant access to the left side (i.e., the more expressive one in humans) of the mother's face (Hauser, 1993). In summary, it is believed that the position of the infants' head during left cradling would facilitate communication between mother and child and that the development of motor asymmetries—including left cradling itself—is related to early hemispheric specialization for perceptual and socio-affective behaviors which emerged early in primate evolution (Manning & Chamberlain, 1991; Parente & Tommasi, 2008; Prete, Malatesta, & Tommasi, 2017). According to this view, the left cradling might facilitate affective interactions in mothers with typical brain organization.

Bogren (1984) investigated the role of handedness and affective symptoms in the directionality of cradling. Whereas no relation between handedness and holding side was observed, an association between cradling on the left side and greater attachment and identification with the parent of the same rather than opposite sex (i.e., mother and father for female and male participants, respectively) was found. Right cradlers also showed more mental symptoms prior to pregnancy, as well as more concern about their pregnancy, their delivery, and the health of the child. Despite Bogren's conclusion that left cradlers, who identified themselves more with the parent of their own sex, are likely better prepared for parenthood, it is hard to generalize such a result because the author did not use a standardized instrument to assess the identification/attachment of cradling parents to their own parents, but only a single item in a self-report questionnaire. Nonetheless, it is plausible to consider the left-cradling behavior as a sensorimotor adaptation allowing the mother to tune in correctly and quickly to the infant's needs. In other words, it might be an important prerequisite for the establishment of a secure bond (e.g., see Huggenberger, Suter, Reijnen, & Schachinger, 2009), as well as a cue of a secure attachment style in the caregiver herself. It was shown, indeed, that the mother's appropriate responses to infant emotional states and signals predict mother–child attachment (Seifer, Schiller, Sameroff, Resnick, & Riordan, 1996), which in turn influences the child's development (Kelly, Slade, & Grienenberger, 2005; Sroufe, 2005). In this regard, Sieratzki and Woll (2004), who observed the cradling preference of deaf and hearing mothers with deaf and hearing children, showed that a complex interaction between hearing status of grandparents, mothers and children influenced the cradling-side preference of mothers and proposed a crucial role for maternal attachment insecurity. Assuming that attachment would ultimately decrease the emotional distance between mother and infant (Bowlby, 1969/1982), the left cradling might increase mother–infant closeness by facilitating visual (Manning & Chamberlain, 1991), auditory (Sieratzki & Woll, 2002) and tactile (Saling & Cooke, 1984) communication. In light of the key role of contact and touch in the development of attachment and bonding (Ainsworth, 1979), it should be noticed that adult humans exhibit a clear population-level lateralization (albeit with a rightward rather than leftward bias) in two other instances of social touch, embracing and kissing. As in the case of cradling, these behavioral asymmetries are influenced to some extent by several factors such as handedness, social pressures and emotional context (see Ocklenburg et al., 2018, for a review), and a role for left cradling has been proposed to account for the fact that parental kissing involves a left-turning bias (i.e., reversed compared to that of romantic kissing). Indeed, according to Sedgewick and Elias (2016), the situation in which parents kiss their children most frequently during the beginning of their children's life is likely when they cradle their infants. Because of the left-cradling bias, parents more often would turn their face to the same side when they kiss their children, and a left-turn kissing bias might persist even after the stage of cradling.

Recently, many researchers (e.g., Lyons-Ruth, Lyubchik, Wolfe, & Bronfman, 2002) suggested that the accelerated development of brain structures during critical periods of infancy—starting during pregnancy and decelerating when the child is 18–24 months old—requires social and communicative experiences acting as triggers and that the cerebral cortex is strongly influenced by inputs coming from the social environment (in particular through the early attachment relationships; Schore, 2005). Although there is a long-standing debate as regards which hemisphere develops earlier (Best, 1988; Chiron et al., 1997; Corballis & Morgan, 1978; Worker & Yeung,

2005), the proposal that in the human species the growth of the right hemisphere seems to take place at a faster pace compared with that of the left hemisphere in the first 3 years of life—and thus before the full emergence of a structured language (Chiron et al., 1997)—is consistent with the notion that the right hemisphere provides a crucial contribution in early attachment interactions and, consequently, in the development of the "social brain" (Brancucci, Lucci, Mazzatenta, & Tommasi, 2009). The neurobiology of attachment, therefore, has also been equaled to an "interpersonal neurobiology of right brain-to-right brain communications" (see Schore, 2005, p. 208).

The crucial interaction between attachment patterns and socio-emotional life is also attested by previous studies showing that, compared with parents with secure attachment styles, those with insecure attachment styles give less emotional support and care to their children during painful situations such as medical therapy (Edelstein et al., 2004; Goodman, Quas, Batterman-Faunce, Riddlesberger, & Kuhn, 1997) and that adults with insecure attachment styles give less support and care to their partners when the latter are faced with an anxious situation (Feeney & Collins, 2001; Simpson, Rholes, & Nelligan, 1992; Simpson, Rholes, Oriña, & Grich, 2002). Interestingly, a recent study linked reduced parental emotional investment—due to extremely dangerous conditions of life—with a reduced left-cradling bias in mothers (Morgan et al., 2018).

In the present study, we aimed to investigate the still inadequately examined link between attachment styles (in terms of parental and romantic bonding) of young females and their cradling preference by using a rigorous and standardized assessment of the variables of interest. In particular, we hypothesized that females showing an optimal bond with parents and a secure attachment in romantic relationships would exhibit a left-cradling bias more often than females showing nonoptimal/insecure attachment. A possible criticism could be that the link between attachment styles and cradling-side preferences might be stronger when examining the cradlers' attachment to their child rather than to their parents or partners. However, it should be stressed that the development of insecure attachments might be due to the child having been reared in inadequate and stressful family contexts. This, especially among females, may translate into behavioral dysfunctions in adolescence such as depression and anxiety (Riskind et al., 2004) and, above all, into dysfunctional reproductive strategies including limited parental investment in the offspring (Belsky, Steinberg, & Draper, 1991; Del Giudice, 2009; Ricks, 1985). Therefore, as already suggested by Bowlby (1969/1982), attachment styles seem to be passed down from generation to generation due to a (vicious or virtuous according to the quality of early environment) cycle starting from the relationship with one's own parents and arriving to the relationship with one's own children (Benoit & Parker, 1994; Cassibba et al., 2017; Hautamäki, Hautamäki, Neuvonen, & Maliniemi-Piispanen, 2010; Obegi, Morrison, & Shaver, 2004), passing through the relationship with one's own partners (Hazan & Shaver, 1987; Obegi et al., 2004; Riskind et al., 2004). Therefore, it is plausible that attachment to parents or partners may represent a valid proxy of attachment to offspring.

In order to test our hypothesis, we examined participants using a lifelike doll, a method that has been largely used in literature (see Damerose & Vauclair, 2002, for a review). Moreover, we decided to test exclusively adult females because only few studies found in males a left-cradling bias comparable to that of females (e.g., Harris, Cárdenas, Stewart, & Almerigi, 2018), with some exceptions for new fathers (Dagenbach, Harris, & Fitzgerald, 1988; Harris, Spradlin, & Almerigi, 2007; Scola & Vauclair, 2010).

Method

Participants

Two hundred and eighty-eight Italian females took part in the study. Their age ranged from 18 to 38 years ($M = 23.58$; $SE = 0.23$), and 17 of them were not right-handers (i.e., scoring zero or negatively on the Italian version of the Edinburgh Handedness Inventory; Salmaso & Longoni, 1985). Participants were not required to provide information about their marital status and parity. All participants gave written informed consent to participate in the study by signing an authorization form. Neither invasive nor risky procedures were involved, and the data were analyzed anonymously. The study was conducted in accordance with the principles of the Declaration of Helsinki. All procedures followed the guidelines of the Italian Association of Psychology Ethical Code and of the Ethical Committee for Research (University of Chieti).

Procedure and Materials

Cradling task. Participants were led by the experimenter in a quiet room in which they performed the cradling task. The experimenter, positioned behind an empty table in front of the participant, informed her that she would have performed a series of trials in which she had to pick up a lifelike doll having the approximate size (45-cm length) and appearance of a baby which was positioned on the table. The participant performed six trials, in each of which the same question was asked: "Imagine that this doll is a real infant who is crying: please take it in your arms and soothe it". After the participant had held the doll for about 8–10 s, the experimenter said: "Thank you, you can put it back on the table". For each trial, the experimenter positioned the doll opposite to the participant, laying it in one of six different positions (whose order was counterbalanced across subjects): supine with the head on the center with respect to the participant (Figure 2A), supine with the head on the left (Figure 2B), supine with the head on the right (Figure 2C), prone with the head on the center (Figure 2D), prone with the head on the left (Figure 2E), and prone with the head on the right (Figure 2F). Participants could see the experimenter placing the doll between consecutive trials, but none of them asked about the role of doll positioning for the task.

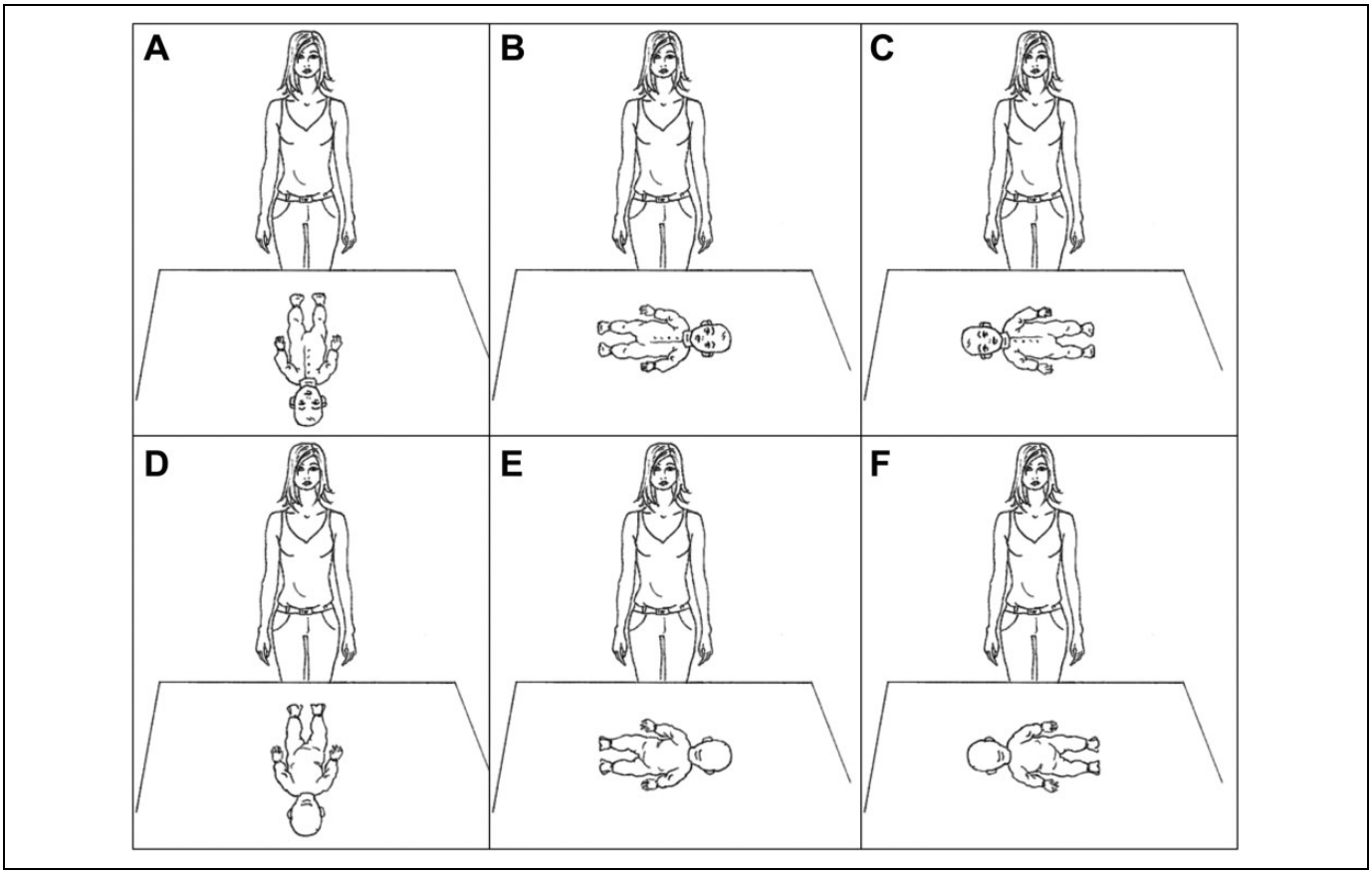

Figure 2. Graphic representation of the six trials performed by each participant in the cradling task.

The experimenter coded each trial in which the participant cradled to the left as −1, each trial in which the participant cradled to the right as +1, and each trial in which the participant cradled to the midline as 0. Therefore, the "cradling-bias index" ranged from −6 (*indicating an absolute left cradler*) to +6 (*absolute right cradler*), with 0 representing no cradling bias at all ("unbiased cradlers"). Participants scoring negatively on the cradling-bias index were labeled as "left cradlers" and those who scored positively were labeled as "right cradlers". Moreover, given that handedness might represent a confounding variable in the assessment of cradling bias, a reduced left-cradling bias having been reported for left-handers (e.g., Huheey, 1977; van der Meer & Husby, 2006), we excluded 17 non-right-handed participants. Therefore, the examined sample consisted of 271 right-handed females (age range: 18–38 years; $M = 23.63$; $SE = 0.24$). After the cradling task, participants were required to fill in the following surveys, which were administered in counterbalanced order across subjects.

Parental Bonding Instrument (PBI). It is a self-report scale consisting of 25 items assessing the participants' perception of the relationship with their mother and 25 items assessing the participant's perception of the relationship with their father during the first 16 years of life (Parker, Tupling, & Brown, 1979; Italian translation by Scinto, Marinangeli, Kalyvoka, Daneluzzo, & Rossi, 1999). Participants answer on a 4-point Likert-type scale in which the scores are computed by adding the score of each item. The PBI assesses the attachment to each parent independently on two bipolar dimensions: "care" (scores ranging from 0 to 36, with a conventional cutoff separating high and low scores, for females, of 27 for the mother version and 24 for the father version) and "overprotection" (scores ranging from 0 to 39, with a conventional cutoff, for females, of 13.5 for the mother version and 12.5 for the father version). These scores assign parents to one of four distinct quadrants as follows: high care–low overprotection, labeled as "optimal parenting" (characterized by affection, emotional warmth, empathy, and closeness), low care–high overprotection, labeled as "affectionless control" (characterized by control, overprotection, intrusion), high care–high overprotection, labeled as "affectionate constraints" (characterized by excessive contact, infantilization, and prevention of independent behavior), and low care–low overprotection, labeled as "neglectful parenting" (characterized by emotional coldness, indifference, and neglect; Parker et al., 1979; Parker, 1983).

Experience in Close Relationships (ECR). It is a self-report scale consisting of two 18-item subscales: The first one represents the attachment-related "Anxiety" Scale (scores ranging from 0 to 108, with a conventional cutoff separating high and low scores of 93.02 for females in the age range 18–20, 90.26 for

Table 1. Sample Distribution of the Scores on the Cradling Bias Index.

Cradling Bias Index								
Left				Unbiased	Right			
−6	−4	−3	−2	0	2	3	4	6
N = 38 (14%)	*N* = 40 (14.8%)	*N* = 1 (0.4%)	*N* = 55 (20.3%)	*N* = 44 (16.2%)	*N* = 40 (14.8%)	*N* = 1 (0.4%)	*N* = 35 (12.9%)	*N* = 17 (6.3%)

females in the age range 21–35, 85.52 for females in the age range 36–65); the second one represents the attachment-related "Avoidance" scale (scores ranging from 0 to 108, with a conventional cut-off separating high and low scores of 63.65 for the age range 18–20, 63.45 for the age range 21–25, 60.05 for the age range 26–65; Brennan, Clark, & Shaver, 1998; Italian version by Picardi and colleagues [2002]). Participants answer on a 7-point Likert-type scale, and scores are computed by adding the score of each items. Regardless of whether an individual is currently in a steady relationship, the ECR questionnaire assesses the degree of attachment security in romantic relationships. These scores assign participants to one of four distinct quadrants as follows: high anxiety—low avoidance, labeled as "preoccupied" (characterized by a desire to gain others' approval and a feeling of unworthiness), low anxiety—high avoidance, labeled as "dismissing" (characterized by passive avoidance of close relationships), high anxiety—high avoidance, labeled as "fearful" (characterized by an active avoidance of close relationships in order to preclude the possibility of rejection), and low anxiety—low avoidance, labeled as "secure" (characterized by high self-esteem and the absence of serious interpersonal problems; Bartholomew, 1990).

Finally, in order to assess the participants' lateral preferences, they were administered the Italian version of the Edinburgh Handedness Inventory (Salmaso & Longoni, 1985). When required, the experimenter debriefed in broad terms the participant about the purpose of the study, without clarifying the variables of interest (i.e., doll position, cradling-side preference, and attachment styles) in order to avoid the possible dissemination of crucial information among future participants.

Results

Cradling Bias

The distribution of the different scores on the cradling bias index is shown in Table 1. Different proportions of left cradlers ($N = 134$ [49.5%]), unbiased cradlers ($N = 44$ [16.2%]), and right cradlers ($N = 93$ [34.3%]) were observed, $\chi^2(2) = 44.952$; $p < .001$. Specifically, a larger proportion of left cradlers rather than unbiased cradlers, $\chi^2(1) = 45.506$; $p < .001$, and right cradlers, $\chi^2(1) = 7.405$; $p = .007$, and a larger proportion of right cradlers rather than unbiased cradlers, $\chi^2(1) = 17.526$; $p < .001$, were observed in our sample.

Cradling Bias According to Doll Positions

When left, center, and right trials were examined separately, participants were labeled as following: 141 (52%) as left cradlers, 88 (32.5%) as unbiased cradlers, and 42 (26.5%) as right cradlers in the left condition, $\chi^2(2) = 54.339$; $p < .001$; 107 (39.5%) as left cradlers, 84 (31%) as unbiased cradlers, and 80 (29.5%) as right cradlers in the center condition, $\chi^2(2) = 4.701$; $p = .095$; and 63 (23.2%) as left cradlers, 107 (39.5%) as unbiased cradlers, and 101 (37.3%) as right cradlers in the right condition, $\chi^2(2) = 12.701$; $p = .002$. In the left condition, a larger proportion of left cradlers rather than unbiased cradlers, $\chi^2(1) = 12.266$; $p < .001$, and right cradlers, $\chi^2(1) = 53.557$; $p < .001$), and a larger proportion of unbiased cradlers rather than right cradlers, $\chi^2(1) = 16.277$; $p < .001$, were observed. In the center condition, a larger proportion of left cradlers rather than right cradlers, $\chi^2(1) = 3.898$; $p = .048$, was observed, whereas the proportions of unbiased cradlers and left cradlers, $\chi^2(1) = 2.770$; $p = .096$, and the proportions of unbiased cradlers and right cradlers, $\chi^2(1) = 0.098$; $p = .755$, did not differ. In the right condition, a larger proportion of right cradlers rather than left cradlers, $\chi^2(1) = 8.805$; $p = .003$, and a larger proportion of unbiased cradlers rather than left cradlers, $\chi^2(1) = 11.388$; $p = .001$, were observed, whereas the proportions of unbiased cradlers and right cradlers, $\chi^2(1) = 0.173$; $p = .677$, did not differ. Furthermore, when supine and prone trials were examined separately, 146 (53.9%) participants were labeled as left cradlers, 1 (0.3%) as unbiased cradler, and 124 (45.8%) as right cradlers in the supine condition, and 156 (57.6%) participants were labeled as left cradlers, 1 (0.3%) as unbiased cradler, and 114 (42.1%) as right cradlers in the prone condition. Once the unbiased cradler (who was the same participant in both cases) was removed, a larger proportion of left cradlers rather than right cradlers was observed in the prone, $\chi^2(1) = 6.533$; $p = .011$, but not in the supine, $\chi^2(1) = 1.793$; $p = .181$, condition. Table 2 shows the occurrences of left, midline, and right responses for each single doll position, as well as the pairwise comparison between left versus right cradling responses (after removing the very few occurrences of midline responses).

Attachment Categories

Given that (i) only 44 participants were categorized as unbiased cradlers, (ii) it would have been problematic to further split this subsample according the various attachment categories, and (iii) we were specifically interested in the relationship between attachment styles and the laterality (left vs. right) of cradling,

Table 2. Number (and Percentage) of Left, Midline, and Right Responses and Pairwise Comparisons Between Left and Right Responses for Each Doll Position (See Figure 2).

Doll Position	Left	Midline	Right	Left Versus Right
Supine left (Figure 2B)	196 (72.3%)	—	75 (27.7%)	$\chi^2(1) = 54.026$ $p < .001$
Supine center (Figure 2A)	150 (55.4%)	1 (0.3%)	120 (44.3%)	$\chi^2(1) = 3.333$ $p = .068$
Supine right (Figure 2C)	99 (36.6%)	1 (0.3%)	171 (63.1%)	$\chi^2(1) = 19.2$ $p < .001$
Prone left (Figure 2E)	173 (63.9%)	2 (0.7%)	96 (35.4%)	$\chi^2(1) = 22.041$ $p < .001$
Prone center (Figure 2D)	147 (54.3%)	—	124 (45.7%)	$\chi^2(1) = 1.952$ $p = .162$
Prone right (Figure 2F)	134 (49.4%)	—	137 (50.6%)	$\chi^2(1) = 0.33$ $p = .855$

we excluded from further analyses such participants because of their limited numerosity and lack of a clear-cut cradling preference. Participant classification according to the attachment categories in maternal, paternal and romantic bonds is described here. As regards the PBI referred to the mother, 64 participants were labeled as having an "optimal parenting", 66 as having an "affectionless control", 64 as having an "affectionate constraint", and 33 as having a "neglectful parenting". As regards the PBI referred to the father, 70 participants were labeled as having an "optimal parenting", 68 as having an "affectionless control", 57 as having an "affectionate constraint", and 32 as having a "neglectful parenting". As regards the ECR categories, 163 participants showed a "secure" attachment in romantic relationships, whereas 27 were "preoccupied", 29 "dismissing", and 8 "fearful."

Given the relatively small numbers of participants falling into several categories, in order to perform the data analysis, all categories different from "optimal parenting" in the PBI or "secure" attachment in the ECR were collapsed. Therefore, for each attachment measure, we compared participants showing optimal/secure attachment with those showing nonoptimal/nonsecure attachment. Table 3 and Table 4 show the sample distribution for the collapsed attachment categories.

Cradling Bias and Attachment to the Mother

As regards the attachment to the mother, participants reporting optimal parenting were significantly more likely to be left cradlers ($N = 42$ [65.6%]) than right cradlers ($N = 22$ [34.4%]), $\chi^2(1) = 6.250$; $p = .012$. On the contrary, although a larger proportion of participants reporting nonoptimal parenting were left cradlers ($N = 92$ [56.4%]) rather than right cradlers ($N = 71$ [43.6%]), no significant difference was observed, $\chi^2(1) = 2.706$; $p = .1$.

Cradling Bias and Attachment to the Father

As regards the attachment to the father, a larger proportion of participants reporting nonoptimal parenting were left cradlers ($N = 92$ [58.6%]) rather than right cradlers ($N = 65$ [41.4%]), $\chi^2(1) = 4.643$; $p = .031$, and the same pattern of results was found in participants reporting optimal parenting, albeit the statistical significance was not reached ($N = 42$ left cradlers [60%] versus $N = 28$ right cradlers [40%]), $\chi^2(1) = 2.8$; $p = .094$.

Cradling Bias and Attachment to the Romantic Partner

As regards the attachment to the romantic partner, participants with secure attachment were significantly more likely to be left cradlers ($N = 102$ [62.6%]) rather than right cradlers ($N = 61$ [37.4%]), $\chi^2(1) = 10.313$; $p = .001$. On the contrary, no statistical difference was shown in participants reporting nonsecure attachment to the romantic partner (left cradlers: $N = 32$ [50%]; right cradlers: $N = 32$ [50%]), $\chi^2(1) = 0$; $p = 1$; see Figure 3 for a general overview of results.

Discussion

In this study, we predicted that the presence of a positive attachment to parents or romantic partners is associated in young adult females to a higher prevalence of left-cradling bias (measured by a doll-task), a potential proxy of positive socio-affective development. On the whole, the present results seem to confirm our predictions.

We presented the doll on which to perform the task 6 times, each time lying in a different position (either supine or prone, and with the head on the left, center, or right of the table), so as to avoid that the overall cradling-bias index might be affected by the doll position. To our knowledge, this is the first study in which the lateral preference was assessed by manipulating the doll position within subjects (previous research only examined the role of the doll head rotation by using between subjects paradigms; Bundy, 1979; Saling & Tyson, 1981). Compared with a "one-shot cradling task", the use of multiple trials allowed to prevent that participants might be erroneously over-categorized as left- or right cradlers. Indeed, those who cradled the doll 3 times on the left and 3 times on the right were classified as unbiased cradlers and were excluded from data analysis. On the other hand, the doll positioning affected

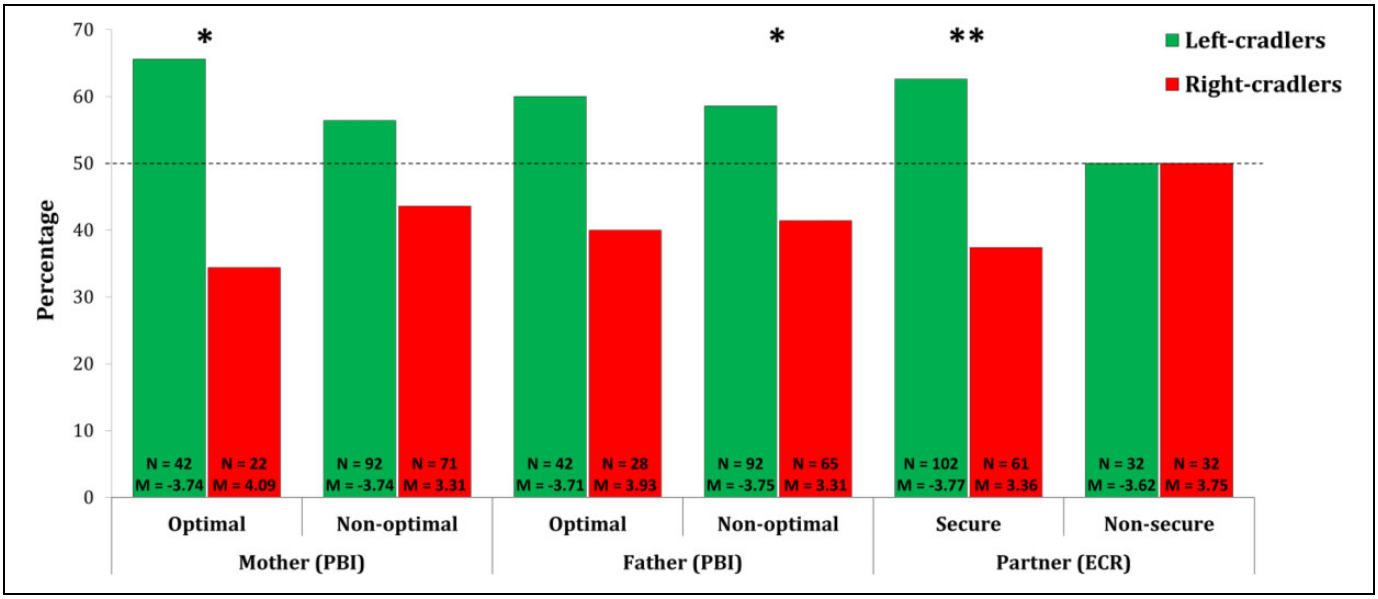

Figure 3. Percentage of left cradlers and right cradlers in participants categorized according to the attachment to the mother, father, and partner (* indicates significance of $p < .05$; ** indicate significance of $p < .005$; the dashed line indicates the chance level [50%]). For each subgroup, participant number (*N*) and mean cradling-bias index (*M*) are presented.

Table 3. Sample Distribution for Attachment Category Regarding the Mother and Father.

Parental Bonding Instrument		
	Mother	Father
Optimal parenting	64	70
Nonoptimal parenting	163	157

Table 4. Sample Distribution for Attachment Category Regarding the Romantic Partner.

Experience in Close Relationships	
Secure	163
Nonsecure	64

significantly participants' responses (which could also account for the relatively low proportion of left cradlers—about 50% if unbiased cradlers were included and about 60% if unbiased cradlers were not included—compared with other studies; see Damerose & Vauclair, 2002, for a review). Specifically, participants gave more left-cradling than right-cradling responses when the doll was positioned with the head on the left, more right-cradling than left-cradling responses when the doll was positioned with the head on the right, and slightly more left-cradling than right-cradling responses when the doll was positioned with the head on the center. The effect of doll positioning turned out to be stronger in the supine condition than in the prone condition. In particular, a larger proportion of right-cradling rather than left-cradling responses was observed in the "supine-right" condition but not in the "prone-right" condition, which could account for why a significantly larger proportion of participants were labeled as left cradlers rather than right cradlers in the prone than in the supine condition. This difference might be due to the fact that in the prone condition, the overwhelming majority of participants rotated the doll so that it faced them, a manipulation that usually moved the doll towards the midline of participants' body and thus probably disrupted the effect of initial doll position. Although we did not record whether the participant reoriented the doll before cradling it in the prone trials, all experimenters stated that almost all participants behaved in such a way. These data show that mechanical factors had a strong influence in our cradling task. In order to exclude such factors and to ensure that what is being measured is cradling rather than picking-up behavior, it would be useful to replicate the present findings with further studies in which either (i) the observations are not done after a few seconds, but after an adaptation period during which participants are invited to relate to the (imagined) crying infant or (ii) women cradling their own infants are observed.

As regards the hypothesized link between attachment styles and cradling bias, it was at least in part confirmed. Indeed, positive attachment styles to the mother or the romantic partner—but not to the father—predicted a higher prevalence of left-cradling bias in our sample. In this regard, some statistical clarifications are needed. In particular, we found a significantly larger proportion of left cradlers rather than right cradlers in participants with a nonoptimal attachment to the father, but not in those with an optimal attachment to the father. However, it should be highlighted that the proportions of left and right cradlers were almost identical in both subsamples, and thus such a result is likely due to the different numerosity of these groups. On the contrary, we found a significantly larger

proportion of left cradlers rather than right cradlers in participants with an optimal attachment to the mother and not in those with a nonoptimal attachment to the mother, despite the former group had a smaller size than the latter. However, it should be stressed that, regardless of whether participants reported optimal or nonoptimal parenting, the majority of them were left cradlers. Thus, the quality of parenting received by participants had limited impact on their cradling-side preferences, whereas the quality of attachment to the partner turned out to have a stronger influence. Furthermore, no linear relationship between the cradling bias index and any of the attachment subscales was found in our data (see Section 2 of the Supplementary Material). However, it is worth highlighting that both the PBI and the ECR include two continuous subscales assessing different dimensions of retrospective attachment, each of which is not "positive" or "negative" per se. Indeed, only a specific combination of the respective subscale scores can be labeled as optimal/secure or nonoptimal/nonsecure. For this reason, we assumed a relationship between left cradling and optimal/secure attachment rather than between left cradling and low or high scores on the single subscales.

It should be pointed out that, in the vast literature on cradling behavior focusing on the relationship between lateral cradling preferences and attachment styles, this is the first report to exploit ad hoc instruments for evaluating the latter. There is convincing evidence supporting the link between cradling asymmetries and various instances of emotional and affective behaviors, such as the establishment of an emotional bond between the cradling and cradled individuals, the interpretation of emotional signals of well-being in children, and the presence of affective symptoms such as depression and anxiety in mothers (Malatesta, Marzoli, Rapino, & Tommasi, 2019; Scola, Arciszewski, Measelle, & Vauclair, 2013; Sieratzki & Woll, 2002; Weatherill et al., 2004). Likewise, there is compelling evidence that positive attachment styles are related positively to optimal caregiving behaviors, organized maternal responsiveness to the emotional states of the child and greater parental investment, as well as negatively to mother's affective mental states, such as depression and anxiety (Belsky et al., 1991; Bifulco, Moran, Ball, & Lillie, 2002; Del Giudice, 2009; Marazziti et al., 2007; Seifer et al., 1996).

From an evolutionary standpoint, it is plausible to hypothesize the existence of a specific and stable cerebral circuitry for attachment in females (e.g., see Zhang et al., 2018). For example, in a neuroimaging study conducted by Lenzi and collaborators (2013) on young women performing a task of empathizing and caregiving toward infant faces, attachment styles were significantly associated to the activity of different brain areas. In particular, dismissing attachment styles were related to a hyperactivation of the limbic and mirror regions, accompanied by a deactivation of fronto-medial areas, and the authors related such a deactivation to the emotional disinvestment toward attachment relationships in dismissing individuals, which would reflect a more cognitive attitude (compared with secure individuals) compensating their unmodulated emotional involvement (Lenzi et al., 2013). Several authors agree in localizing such socio-emotional and empathic processes in the right hemisphere of the brain (Brancucci et al., 2009; Horton, 1995; Schore, 2005). With the present study, we provide further support to this scenario, suggesting that the left-cradling bias in females—probably because of the right-hemisphere dominance for processing of socio-emotional stimuli—might be linked to positive attachment styles to both the mother (i.e., the most important parental figure in childhood) and the romantic partner.

A limitation of this study could be that we did not assess women's attachment to their own children, which could be more strongly related to the laterality of cradling behavior than attachment to parents or partners. However, as said above, it should be stressed that attachment to parents seems to be reflected in attachment styles toward partners and, successively, toward offspring. In this regard, both cross-sectional and longitudinal studies showed that internal working models of attachment are stable at least across three generations (Benoit & Parker, 1994), especially in terms of attachment security (Cassibba et al., 2017; Hautamäki et al., 2010). In particular, maternal attachment insecurity during childhood predicts anxiety with regard to adult romantic attachment (Riskind et al., 2004). The importance of the early parent–infant interaction on later romantic relationships has been confirmed by many authors (Belsky et al., 1991; Del Giudice, 2009; Hazan & Shaver, 1987; Obegi et al., 2004; Ricks, 1985). It should be also noticed that our data (see Section 3 of the Supplementary Material) confirm the results of previous studies according to which attachment to parents (measured by means of PBI) is correlated to attachment to partners (measured by means of ECR; e.g., Guerrero, 2015).

It is plausible that if we had collected ad hoc data in a sample of mothers, we would have also found a consistence between attachment to their parents and partners and attachment to their infants. In this regard, a further limitation of our study is that information on participants' marital status (or participants' involvement in a relationship) and parity was not collected. However, among Italian women, the average age for marriage is 31.9 years and that for having the first child is 31 years in 2016 (source: European Union, 2018). Given that in our sample the overwhelming majority of participants were university students and only 16 of them were over 31 years, it is likely that a negligible percentage of them were married and/or mothers. However, we observed a weak correlation between age and left-cradling bias (see Section 1 of the Supplementary Material). Future studies specifically designed to investigate how age, marital status and parity interact with attachment styles in shaping cradling preferences are warranted.

In summary, the present results confirm that left cradling can be considered a typical behavior in humans and right cradling an atypical behavior. Such preferences might be related to a variety of different factors such as anxiety, stress, depression, and even attachment style (e.g., Bogren, 1984; Scola et al., 2013; Sieratzki & Woll, 2002; Weatherill

et al., 2004). Dysfunctions in socio-emotional states and attachment styles seem to reduce the typical left-cradling bias which is nonetheless the predominant pattern also in women with moderate symptoms, and it is plausible that only when dysfunctions are meaningful the cradling behavior is significantly influenced. As stressed by Collins and Read (1990), attachment styles may influence both affect and cognition, as well as the quality of close relationships and their outcome in social life. For example, it has been shown that people with secure attachments in romantic relationships have relationships characterized by greater intimacy and confidence and, more generally, that nonsecure attachment is strictly associated with social anxiety and depression, all these conditions reflecting the presence of negative cognitive styles (Eng, Heimberg, Hart, Schneier, & Liebowitz, 2001). In other words, attachment is capable of influencing human life "from the cradle to the grave" (see Bowlby, 1969/1982, p. 129) and of orienting all human social behaviors. Similarly to positive and negative attachment patterns (e.g., Benoit & Parker, 1994), cradling-side preferences can be transmitted from one generation to the other, as shown by Manning and Denman (1994), which further corroborates the view that optimal and secure attachment patterns shown by left-cradling mothers seem to reflect the optimal emotional information they can provide to their children during early childhood, which in turn can also facilitate the development of typical brain asymmetries as measured in adulthood (e.g., see Hendriks, van Rijswijk, & Omtzigt, 2011; Vervloed, Hendriks, & van den Eijnde, 2011). It is also noteworthy that the proportion of left cradlers did not differ between participants showing optimal and nonoptimal attachment to their fathers. In this regard, we know that cradling interactions between father and child are less frequent and less side-biased compared with those involving the mother (e.g., see Damerose & Vauclair, 2002), and thus it could be argued that their disruption might elicit milder consequences on subsequent social and affective behaviors.

To sum up, given that secure attachment styles are related to optimal caregiving behaviors and organized responsiveness to the emotional states of other individuals, including children (Bifulco et al., 2002; Marazziti et al., 2007; Seifer et al., 1996), we propose that the left-cradling bias may be a natural index of socio-emotional attunement between the cradling and cradled individuals. Consistent with this proposal, de Château and Andersson (1976) showed that right-cradling mothers were less responsive to signals coming from their child and were more concerned about his or her health, and Sieratzki and Woll (2002) associated left cradling with high-quality social attachment and communicative behaviors in mothers. Finally, our findings corroborate the hypothesis that left-cradling bias in females is linked to innate attachment processes allowing individuals to relate to others, which in turn could foster the socio-emotional bond between mother and child and, lastly, improve their well-being.

Acknowledgments

The authors are grateful to Rossella Panarese, Noemi Carrieri, Christel Lorusso, and Michela Scinto for their help in collecting data. Also, they wish to thank Rocco Cannarsa for drawing Figures 1 and 2. Finally, the authors thank Prof. Lauren J. Harris and another anonymous reviewer whose valuable comments improved an earlier version of this manuscript.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

ORCID iD

Gianluca Malatesta https://orcid.org/0000-0002-7658-2364

Supplemental Material

Supplemental material for this article is available online.

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