Leftward cradling bias is not disrupted by depressive and anxiety symptoms in nulliparous females

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Abstract

Across various populations, the majority of females exhibit a leftward cradling bias when soothing or putting an infant to sleep. Various early hypotheses have tried to explain this phenomenon, but lack empirical support. Recent research supports the theory that right hemisphere functions for emotion processing underlie the leftward cradling bias, specifically the innate processes of relating to others. Depression and anxiety have been found to disrupt right hemisphere functions, but studies have been inconclusive about the association between cradling bias and depression and/or anxiety. This study hypothesised that the leftward cradling bias would be disrupted (i.e., reduced bias or reversed) in nulliparous females who scored high on depressive and/or anxiety symptoms. Nulliparous female undergraduate psychology students ($N = 179$) took part in an online survey measuring depressive and anxiety symptoms as well as a face-to-face session which included a cradling bias task and a handedness questionnaire. In keeping with previous findings, a leftward cradling bias of 76% was observed. However, there was no significant association between cradling bias and depression and/or anxiety symptoms. Potential reasons for this unexpected finding are discussed, highlighting the need for future research to investigate cradling bias in samples with clinical depression and anxiety.

Keywords: ability to relate; anxiety; cradling bias; depression; emotion processing; nulliparous females.

Around 65 to 85% of females prefer to cradle an infant to the left side of their body when soothing or trying to put an infant to sleep (see Harris, 2010). This leftward cradling bias has been seen across samples, with the majority of females exhibiting this phenomenon throughout different cultures and historical periods (Richards & Finger, 1975; Saling & Cooke, 1984). While this bias is not as prominent in males (Damerose & Vauclair, 2002; de Chateau & Andersson, 1976; Turnbull & Lucas, 1991), it has been observed at the same proportion in new and older fathers (Bourne & Todd, 2004). This suggests that it becomes more pronounced in males with parenting experience. Leftward cradling bias has also been found in nonhuman primates (Hopkins, 2004; Manning, Heaton, & Chamberlain, 1994). In light of the extent to which the leftward cradling bias has been observed, it is not surprising that some have suggested that an innate biological mechanism may be responsible for this phenomenon.

While the mechanism underlying this leftward cradling bias is not yet well-understood, various explanations have been proposed (see Jones, 2017). While early explanations lack empirical support, recent studies have linked leftward cradling bias to the lateralisation of the right hemisphere for emotion processing in most people (Bourne & Todd, 2004). Lately, the argument that an innate social-emotional mechanism (i.e., the ability to relate to others) is responsible for this bias has been advocated (Fleva & Khan, 2015; Pileggi, Malcolm-Smith, & Solms, 2015; Sieratzki & Woll, 2002). Linked to this theory of an innate social-emotional mechanism, recent research suggests that there may be an association between cradling bias and depression and/or anxiety (Scola, Arciszewski, Measelle, & Vauclair, 2013).

Depression and anxiety have been associated with compromised right hemisphere functioning for emotion processing, which may disrupt the innate mechanism that facilitates the leftward cradling bias (Demenescu, Kortekaas, den Boer, & Aleman, 2010; Scheuerecker et al., 2010). Additionally, studies have found that mothers with postnatal depression are less responsive to and communicative with their infants, exhibiting a disturbed quality of interaction and difficulty with relating to their infant (Arteche et al., 2011; Field, 2010). Considering this, individuals with depression and/or anxiety might be less likely to cradle to the left. This study investigates the association between cradling bias and depressive and/or anxiety symptoms in a sample of neurotypical females to provide further insight into the proposed underlying social-emotional mechanism of the leftward cradling bias.

Early explanations

Two early explanations for the leftward cradling bias include the handedness and the heartbeat hypotheses (see Harris, 2010). The handedness explanation states that holding an infant with the non-dominant arm frees the dominant arm for interaction with the infant and the ability to multi-task (Huheey, 1977). Consequently, most people will cradle to the left as the majority of individuals are right-handed (Annett, 1967). While this explanation supports observations of functional cradling, which occurs when the holder is cradling while performing other actions such as feeding (van der Meer & Husby, 2006), it does not adequately explain non-functional cradling, where the infant is cradled for the sole purpose of soothing or putting the infant to sleep. In cases of non-functional cradling – which is what this study is interested in - handedness has not been associated with cradling side (Forrester, Davis, Mareschal, Malatesta, & Todd, 2018; Harris, Cárdenas, Stewart, & Almerigi, 2018).

The heartbeat hypothesis proposes that cradling the infant to the left allows the infant to better hear the holder's heartbeat, which is thought to be soothing and mimic the soporific effect in utero (Salk, 1973). This has poor support with scepticism around whether the infant can even hear the heartbeat, and also that the cradling position does not match where the heart is anatomically situated (Dagenbach, Harris, & Fitzgerald, 1988; Philbin & Klass, 2000). Given these critiques, research has moved towards investigating other explanations for the leftward cradling bias, of which cerebral explanations have gained much support.

Right hemisphere explanations

According to a review by Jones (2017), the leftward cradling bias can best be explained by emotion processing being lateralised to the right hemisphere of the brain. Cradling the infant to the left is advantageous for both the holder and the infant to optimally process visual and auditory information related to emotion (Manning & Chamberlain, 1991; Sieratzki & Woll, 1996; Vauclair & Donnot, 2005). A left visual field preference has also been observed in both mother and infant terrestrial and marine non-primate mammals. This has been attributed to the right hemisphere specialisation for emotion processing which allows the mother to better monitor their infant (Giljov, Karenina, & Malashichev, 2018). The left-hemispace bias has also been linked to arousal-attentional processing (Harris, Almerigi, Carbary, & Fogel, 2001), which supports the idea that leftward cradling facilitates infant monitoring by allowing the mother to better attend to her infant (Huggenberger, Suter, Reijnen, & Schachinger, 2009; Todd & Banerjee, 2016).

Across the years, several investigators have highlighted a possible connection between rightward cradling and reduced quality of caregiver-infant interactions (Bogren,

1984; de Chateau, Holmberg, & Winberg, 1978; Pileggi et al., 2015). In a recent study, Jooste (2018) found an association between rightward cradling and insecure-avoidant attachment style, suggesting that difficulties with relating to the infant and attending to their needs may play a role in cradling behaviour. Insecure attachment styles in caregivers are associated with diminished quality of the caregiver-infant relationship and decreased sensitivity to the needs of their infant (e.g., Mazzeschi, Pazzagli, Radi, Raspa, & Buratta, 2015). Furthermore, individuals with insecure attachment styles are more likely to process social information with a negative bias or to defensively prevent potentially harmful information from being processed (Dykas & Cassidy, 2011). In light of the right hemisphere's dominant role in behaviours involving social attachment, emotional communication and attentional processing, an argument can be made that leftward cradling is driven by socio-affective processes and could be beneficial in facilitating the caregiver-infant relationship (Bourne & Todd, 2004; Sieratzki & Woll, 2002).

Most recently, the specific cerebral explanation that an innate biological mechanism that facilitates relating to others may be responsible for the leftward cradling bias has gained support. Pileggi et al. (2015) found that in a sample of children diagnosed with autism spectrum disorders (ASDs), a population characterised by having difficulties with relating to others, the leftward cradling bias was absent. These observations were supported in a study that demonstrated that adults high on autistic traits were less likely to cradle to the left (Fleva & Khan, 2015). Additionally, Pileggi et al. (2015) included a group of intellectually disabled children as a control group and showed that higher cognitive functions do not mediate the leftward cradling bias, supporting the argument of a basic biological mechanism at play. Interestingly, recent research has found that children who cradled to the left scored more highly on social ability tests than their right cradling counterparts (Forrester et al., 2018). These findings support the notion that innate social affective processes that facilitate relating to others, which are compromised in individuals with ASDs, are important in understanding the leftward cradling bias.

Effect of depression and/or anxiety

Recently, researchers have begun to focus on the prevalence of cradling bias in individuals diagnosed with depression and/or anxiety, another population with compromised social-emotional abilities (Scheuerecker et al., 2010; Szanto et al., 2012). Depression and anxiety have been linked to impaired emotion processing, associated with an impairment in facial emotion recognition (Demenescu et al., 2010). Furthermore, impaired facial emotion processing has been found in mothers with postnatal depression, which may have

implications for caregiver-infant interaction quality and attentiveness to infant affect (Arteche et al., 2011; Sieratzki & Woll, 2002). If cradling bias does indeed function for infant monitoring via an innate social-affective relating mechanism, it would be expected that impaired emotion processing, as seen in conditions such as depression and/or anxiety, would disrupt the leftward cradling bias.

A handful of studies have investigated the effect of negative emotional states on cradling bias, but findings have been inconsistent. For example, studies have found that stressed and depressed mothers, as well as those who were only stressed, were significantly more likely to cradle to the right than to the left, but mothers who were only depressed still exhibited the leftward cradling bias (Reissland, 2000; Reissland, Hopkins, Helms, & Williams, 2009). In contrast, Weatherill et al. (2004) observed reduced cradling to the left in mothers who reported having depressive symptoms. However, the depression variable could have been confounded by the stress invoked by the Strange Situation, a procedure measuring attachment, which was employed in this study (Reissland et al., 2009). Therefore, it is important that the concepts of depression and anxiety, as well as anxiety and stress, are defined and studied appropriately to avoid inconsistent results. Vauclair and Scola (2008) noticed that depressed mothers were more likely to cradle their infant to the right as well as to alternate between arm- and shoulder-holding. Further discrepancies in cradling preference have been found between multiparous and nulliparous females as well as before and after birth (Scola et al., 2013; Suter, Huggenberger, Blumenthal, & Schachinger, 2011; Vauclair & Scola, 2009). In light of the inconsistency between findings in these studies, more research is necessary to investigate the association between cradling bias and depression and/or anxiety.

Rationale, Aims and Hypotheses

While recent studies have provided much support for the leftward cradling bias, the underlying mechanism is still unclear. The literature favours a cerebral explanation, particularly the right hemisphere's specialised role in emotion processing (Jones, 2017). More specifically, basic right hemispheric functions, involved in the ability to relate to others, have been implicated through the suggestion that leftward cradling facilitates better relating in caregiver-infant interactions (Pileggi et al., 2015). If this is indeed true, a reduced or reversed leftward cradling bias can be expected in individuals with disrupted right hemisphere functioning with regards to emotion processing, such as individuals diagnosed with depressive and/or anxiety disorders (Scheuerecker et al., 2010). However, findings from depressed and/or anxious samples have been mixed thus far. This study investigated the association between cradling bias and depressive and/or anxiety symptoms. The aim of this

study was to shed more light on whether depressive and/or anxiety symptoms disrupt the leftward cradling bias and provide further insight into the innate mechanism underlying the phenomenon of leftward cradling. This study examined the following hypotheses:

1) High depressive symptoms will be associated with a decreased likelihood of leftward cradling.

2) High anxiety symptoms will be associated with a decreased likelihood of leftward cradling.

3) The combination of high depressive and anxiety symptoms will be associated with a decreased likelihood of leftward cradling.

Methods

Design and Setting

A cross-sectional correlational design and quantitative research method were used to investigate the association between cradling bias and the presence of depression only (i.e., high depressive symptoms), anxiety only (i.e., high anxiety symptoms) as well as the combination of high depressive and anxiety symptoms. Participants completed an online survey that consisted of self-report measures of depressive and anxiety symptoms, while the cradling task and handedness questionnaire took place in a quiet, distraction-free room in the University of Cape Town (UCT) Department of Psychology. The cradling task consisted of four trials to allow participants to have no bias. Participants were kept blind to the researcher's measurement of cradling side so that this awareness did not influence the results.

Participants

Participants were recruited using convenience sampling through the UCT Department of Psychology's Student Research Participation Programme (SRPP) for undergraduate psychology students. Only nulliparous females were included because it is unclear whether parenting experience influences cradling side preference (Bourne & Todd, 2004). Males were excluded because the leftward cradling bias is considered by some to be less prominent in males (e.g., Damerose & Vauclair, 2002). Individuals who self-reported a previous clinical diagnosis of depressive and/or anxiety disorders were included, as this research investigates how depressive and/or anxiety symptoms may be associated with cradling side preference. Individuals with other clinical diagnoses, such as autism spectrum disorders (ASDs) or bipolar disorder, were excluded. This was necessary to limit the influence that other diagnoses might have on cradling bias, especially ASDs which has been found to disrupt the leftward cradling bias (Fleva & Khan, 2015; Pileggi et al., 2015).

A total of 352 participants took the online survey, but only 196 participants attended the follow-up face-to-face session. Of the 17 participants that were excluded, 14 participants were excluded due to clinical diagnoses that were not depressive or anxiety disorders and three participants were excluded because they had a child. Therefore, a final sample of 179 participants, between the ages of 18 and 35 years, was obtained.

Measures

Demographic questionnaire. Participants completed a basic demographic questionnaire (see Appendix A) including questions pertaining to age, caregiving experience, and psychological history (i.e., previous or current clinical diagnoses). For example, participants were asked if they had ever received a clinical diagnosis (e.g., depression, anxiety, ASDs).

Beck Depression Inventory-II (BDI-II). The BDI-II was used to measure the presence and severity of depressive symptomology (Beck, Steer, & Brown, 1996). This questionnaire is comprised of 21 self-report items with a range of four possible answers (see Appendix B). For example, the item examining sadness has four possible responses: (0) I do not feel sad; (1) I feel sad much of the time; (2) I am sad all of the time; (3) I am so sad or unhappy that I can't stand it. This widely-used measure has been shown to have good internal consistency, test-retest reliability, and validity (Beck et al., 1996; Dozois, Dobson, & Ahnberg, 1998). The BDI-II has also been shown to have good psychometric properties when used for research in South Africa (Kagee, Nel, & Saal, 2014).

Beck Anxiety Index (BAI). The BAI was used to measure the presence and severity of anxiety symptomology (Beck, Epstein, Brown, & Steer, 1988). This questionnaire is comprised of 21 self-report items with a range of four of possible answers (see Appendix C). For example, the item examining nervousness has four possible responses: (0) Not at All; (1) Mildly; (2) Moderately; (3) Severely. The BAI is useful because it was designed for clinical populations and to distinguish between depression and anxiety (Julian, 2011). This widely-used measure has been shown to have good reliability and validity in various populations (Beck et al., 1988; Osman et al., 2002). The BAI has also been shown to have good psychometric properties when used for research in South Africa (Kagee, Coetzee, Saal, & Nel, 2015).

Cradling bias task. The cradling bias task used was adopted from a study by Jooste (2018), which was an adaptation of the task utilised by Pileggi et al. (2015). The researcher offered the participant a life-like doll in an upright position at the participant's midline and asked the participant to imagine that the doll was a real infant about to fall asleep. The

research told participants that they could place the doll in an imaginary cot (a folded blanket on a desk) when they thought it was asleep. Participants were informed that if the baby (i.e., the doll) started crying, they should pick it up and soothe it back to sleep.

The researcher covertly activated the crying sound from their mobile phone that was linked to a hidden speaker in the cot. The crying sound for the doll played after intervals of one minute so that the independent trials provided reliable data. Three formal trials and one informal trial (when the participant was first given the doll) were utilised to note preferred cradling side (i.e., where the participant placed the doll's head in relation to their visual field). Cradling bias was determined by the side that a participant cradled on for the majority of the task and the total of four trials accommodated for participants with no cradling side preference.

Edinburgh Handedness Inventory (EHI). The original version of the EHI was used to measure dominant handedness (Oldfield, 1971). This questionnaire is comprised of 12 self-report items with a range of five possible answers (see Appendix D). For example, the item examining writing has five possible responses: (100) Always right; (50) Usually right; (0) Both equally; (-50) Usually left; (-100) Always left. The laterality quotient of each participant was calculated and they were categorised as right-handed, mixed-handed or left-handed. This widely-used measure has been shown to have good test-retest reliability and is commonly used in psychological research (Edlin et al., 2015; Ransil & Schachter, 1994). The EHI has also been used for research in South Africa (Jooste, 2018; Kopiez et al., 2011).

Procedure

The study was advertised to female undergraduate psychology students via an announcement (see Appendix E) on the Student Research Participation Programme (SRPP) site on Vula (i.e., the online platform for all UCT courses, societies and programmes). This announcement included the link to the online survey. The online survey contained information on the study and acknowledgement of informed consent (see Appendix F) as well as the demographic questionnaire, the BDI-II and the BAI. The online survey took participants an average of 12 minutes to complete. All participants who completed the online survey were emailed by the researcher to book a face-to-face session via an online booking site with the available time slots.

The face-to-face session took place in a room in the UCT Department of Psychology where participants completed the cradling bias task and the EHI. During this session, the researcher spoke to the participant about their SRPP information as well as their child experience and psychological history for consideration of the exclusion criteria. The face-to-

face session took participants between five and 10 minutes to complete. After finishing both parts of the study, participants received 2 SRPP points as compensation approximately one week later and were emailed a debriefing letter (see Appendix G) at the end of the data collection period.

Ethical considerations

Ethical approval was obtained from the UCT Faculty of Humanities' Ethics Review Committee (reference number: PSY2018-031; see Appendix H). The first page of the online survey informed participants on the nature of the study, the possible risks and benefits, the confidentiality of all information obtained in the study as well as the fact that participation in the study was voluntary and could be terminated at any time. Participants were required to acknowledge their informed consent before answering any of the questionnaires in the online survey. Participants were emailed a debriefing letter after data collection was complete because they were not made aware of the full nature of the study at the time of their participation (to prevent an awareness of the measurement of cradling side from influencing their behaviour). In consideration of the possibility that participants might be upset after taking the online survey with questionnaires about the symptoms of depression and anxiety and/or answering the questions in the face-to-face session about one's psychological history, the debriefing letter also contained the contact details for multiple sources of help and support (e.g., UCT Student Wellness Services). All participant identifying information was removed for data analysis.

Data analysis

All statistical analyses were completed using IBM SPSS Statistics (version 25) with the level of statistical significance set at $\alpha = .05$ (Field, 2009). Data was scored according to the relevant guidelines for each measure and then categorised into appropriate groups concurring with the interpretation information in these guidelines.

The presence of depressive and/or anxiety symptoms was categorised according to the BDI-II and BAI scores and levels of Minimal, Mild, Moderate or Severe symptoms. The Minimal and Mild categories were grouped into No Depression/Anxiety (< 19 on BDI-II and < 15 on BAI). The respective Moderate and Severe categories were grouped into Depression Only (> 20 on BDI-II), Anxiety Only (> 16 on BAI) and Both Depression and Anxiety (> 20 on BDI-II and > 16 on BAI). Handedness was categorised according to the EHI scores and calculated laterality quotient as Left (-100 to -61), Mixed (-60 to 60) or Right (61 to 100). For the cradling bias task, each left cradle was scored as -1 and each right cradle was scored as +1. Cradling bias was categorised as Left (-3 or -4) or Not Left (> -3).

Descriptive statistics. Means and standard deviations were computed for all continuous variables including age, EHI scores, BDI-II scores and BAI scores. Frequencies were calculated for categorical variables including cradling side, previous/current diagnosis of depressive and/or anxiety disorder, consistency of cradling to one side, handedness and presence of depressive and/or anxiety symptoms.

Chi-squared analyses. Separate chi-squared analyses were used to test the association between cradling bias and handedness, cradling bias and depression only, cradling bias and anxiety only as well as cradling bias and the combination of both depression and anxiety. These were all categorical variables with two independent categorical groups (except for handedness, which had three groups), therefore the data upheld the assumptions for the chi-square test for independence.

While regression analyses would have been preferable, the data violated the assumptions required for regression, particularly normality. The range of the data was restricted by the nature of a non-clinical sample. Specifically, most scores were skewed toward the lower end of the range of possible scores. Chi-squared analyses were used to avoid any results that would reveal associations which could well be an artefact of the data rather than an actual effect. The depression and anxiety variables were categorised with consideration of the possible interaction effect between depression and anxiety.

Results

Descriptive statistics

A total of 179 nulliparous female undergraduate psychology students, aged between 18 and 35 years ($M = 20.45$, $SD = 1.88$), completed all measures. The majority of participants (79%) self-reported that they had never received a clinical diagnosis for depression and/or anxiety before, although only 42% of participants were categorised as having low scores for depression and anxiety after completing the BDI-II and BAI. The majority of participants (86%) cradled consistently to one side for all four trials. In keeping with what is seen in previous literature, an overall leftward cradling bias of 76% was found.

The EHI measure has a high level of internal consistency with a Cronbach's alpha of .93. As is to be expected, the overall mean EHI score ($M = 66.73$) falls into the right-handed classification. The EHI scores have a high standard deviation ($SD = 43.68$), but this can be expected when participants mostly score at opposite extremes of right- and left-handedness. The majority of participants were categorised as Right-handed (81%), followed by Mixed-handed (13%) and Left-handed (6%).

Both the BDI-II and BAI measures have a high level of internal consistency with values for Cronbach's alpha of .91 and .92, respectively. The overall mean BDI-II score (M = 12.91, SD = 9.61) falls into the Minimal category for depressive symptoms. The overall mean BAI score (M = 18.60, SD = 11.94) falls into the Moderate category for anxiety symptoms. The Minimal and Mild groups as well as the Moderate and Severe groups were combined and used to form the following categories: No Depression/Anxiety (Minimal/Mild for both BDI-II and BAI scores), Depression Only (Minimal/Mild for BAI scores, but Moderate/Severe for BDI-II scores), Anxiety Only (Minimal/Mild for BDI-II scores, but Moderate/Severe for BAI scores) and Both Depression and Anxiety (Moderate/Severe for both BDI-II and BAI scores). Most participants were categorised as No Depression/Anxiety (42%), followed by Anxiety Only (35%), Both Depression and Anxiety (20%) and, with very few participants, Depression Only (3%).

The descriptive statistics for each of these categories and their relative BDI-II and BAI scores are represented in Table 1. For the No Depression/Anxiety category, the average BDI-II and BAI scores both fall within the Minimal level of symptoms. For Depression Only, the average BDI-II score falls within the Moderate level of depressive symptoms, while the average BAI score falls within the Mild level of symptoms. For Anxiety Only, the average BDI-II score falls within the Minimal level of symptoms, while the average BAI score falls within the Moderate level of symptoms. For Both Depression and Anxiety, the average BDI-II score falls within the Moderate level of symptoms, while the average BAI score falls within the Severe level of symptoms. The standard deviation for BAI scores in the Both Depression and Anxiety category is quite high, but this can be explained by the broader range of scores in the Moderate and Severe levels (16 to 63) compared to the Minimal and Mild levels (0 to 15) as well as some participants having extreme scores.

Table 1

Descriptive statistics

	Measure	
	BDI-II	BAI
No Depression/Anxiety (n = 76)	6.87 (4.90)	8.14 (3.86)
Depression Only (n = 5)	25.00 (3.39)	11.40 (3.51)
Anxiety Only (n = 62)	10.73 (4.73)	23.73 (6.88)
Both Depression and Anxiety (n = 36)	27.75 (6.50)	32.83 (10.44)

Note. Means presented with standard deviations in parentheses. BDI-II = Beck Depression Inventory-II; BAI = Beck Anxiety Index.

Chi-squared analyses

Several chi-square tests of independence were conducted to investigate if cradling bias was significantly associated with handedness, high depression only, high anxiety only and/or the combination of high depression and anxiety. As expected, cradling bias was not contingent on handedness, χ^2 (2, $N = 179$) = 5.72, $p = .057$. There was, however, no statistically significant association between cradling bias and depression only (χ^2 [1, $N = 179$] < 0.01, $p = .955$), anxiety only (χ^2 [1, $N = 179$] = 0.19, $p = .660$) or the combination of depression and anxiety (χ^2 [1, $N = 179$] = 1.21, $p = .272$).

Discussion

This study examined the association between cradling bias and measures of depression and anxiety. In doing so, the goal was to provide further support for the theory that cradling is facilitated by right hemisphere functions for emotion processing, specifically, an innate ability to relate to others. It was hypothesised that depressive and/or anxiety symptoms would disrupt the leftward cradling bias because these conditions are associated with right hemisphere dysfunctions in emotion processing (Demenescu et al., 2010; Scheuerecker et al., 2010; Szanto et al., 2012). In keeping with previous findings, this study found that 76% of participants exhibited a leftward cradling bias (e.g., Harris, 2010; Jones, 2017). Most participants (86%) also cradled consistently to one side, suggesting that any bias was not disrupted in most participants. These findings are aligned with expectations for a sample of neurotypical individuals. Additionally, in keeping with previous research, cradling bias was not contingent on handedness (Forrester et al., 2018). Contrary to expectations, cradling bias was not significantly associated with depressive symptoms, anxiety symptoms, or the interaction between depressive and anxiety symptoms.

The lack of a significant association between cradling bias and depressive and/or anxiety symptoms adds to the inconsistency of results found in previous studies (i.e., Donnot, Vauclair, & Bréjard, 2008; Reissland et al., 2009; Vauclair & Scola, 2008, 2009; Weatherill et al., 2004). To elaborate, while some studies have found depression to be associated with disrupted cradling bias, other studies have not. The inconsistencies between past studies could at least in part be linked to using a non-clinical sample, comorbidity of depression and anxiety, interchangeable measurement of anxiety and stress, as well as the use of self-report measures. There have also been methodological inconsistencies between how cradling is defined and different styles of holding an infant (i.e., arm- and shoulder-holding). The lack of significant results for this study, however, is not to be considered conclusive evidence that depression and/or anxiety does not disrupt cradling bias. It is possible that no significant

association between cradling bias and depressive and/or anxiety symptoms was found due to the use of a neurotypical sample. Most participants scored low levels of depressive and anxiety symptoms, cradled consistently and displayed a leftward cradling bias, as would be expected of a neurotypical sample.

However, recent research in this field provides enough preliminary support to still consider that depression and/or anxiety may play a role in disrupting the leftward cradling bias, similarly to ASDs (Fleva & Khan, 2015; Pileggi et al., 2015). Therefore, more research is required to build the explanation that cradling bias is facilitated by right hemisphere functions for emotion processing, specifically an underlying innate mechanism for relating to others (Jones, 2014). Previous literature has found an absence of this phenomenon in populations with autistic traits (Fleva & Khan, 2015; Pileggi et al., 2015) and another population with believed deficits in relating to others are individuals diagnosed with depressive and/or anxiety disorders (Demenescu et al., 2010; Scheuerecker et al., 2010; Szanto et al., 2012). The inconsistency between findings for cradling bias in participants with depression and/or anxiety is a call for more research to further investigate and clarify whether these conditions are associated with a disrupted leftward cradling bias.

This research is necessary because it is important to understand which populations exhibit a disrupted leftward cradling bias. This knowledge contributes to explaining how the innate social-emotional mechanism facilitates cradling bias as well as the practical applications. While cradling bias should not be used as a diagnostic tool, it can be informative when studying populations who have impaired or disrupted social-emotional processing, such as ASDs as well as depressive and anxiety disorders (Pileggi et al., 2015; Scheuerecker et al., 2010; Szanto et al., 2012). Research in this field is also valuable to better understand the possible implications of cradling bias.

A deeper understanding of the innate mechanism underlying cradling bias can inform future studies investigating the caregiver-infant relationship. It is well-known that the caregiver-infant relationship is valuable for attachment processes and to promote quality of care (e.g., Tronick, 2017). This is particularly relevant in light of recent research that has found an association between rightward cradling and insecure-avoidant attachment, which is associated with reduced quality of caregiver-infant interactions (Jooste, 2018). Furthermore, a considerable proportion of mothers are diagnosed with postnatal depression (between 20 to 40%), which is associated with reduced communication with and sensitivity to their infant, diminishing the quality of the caregiver-infant relationship (Arteche et al., 2011; Field, 2010). New mothers with high anxiety symptoms are also likely to have suboptimal caregiver-infant

relationships (Reck, Tietz, Müller, Seibold, & Tronick, 2018). If the leftward cradling bias is indeed disrupted by insecure attachment, depression and anxiety, this is valuable knowledge, especially regarding the possible implications on the caregiver-infant relationship.

In contrast with previous findings as well as this study's results, Morgan, Hunt, Sieratzki, Woll and Tomlinson (2018) recently investigated cradling bias in a South African sample with adverse socioeconomic conditions and did not find a leftward cradling bias. In fact, most participants showed no side preference, followed by a right side preference. Interestingly, participants that showed no bias tended to have higher scores for a measure of parental stress. Considering that stress is different to clinical anxiety, it would be interesting to investigate whether depression and/or anxiety would also have an association with disrupted leftward cradling bias in a similar sample. This study should be replicated and extended (i.e., include depression and anxiety as variables), because if parents living in adverse, stressful environments are less likely to cradle their infant to the left, this may have negative effects on the quality of caregiver-infant relationships and subsequent development.

Limitations and recommendations for future research

A prominent limitation of this study is the nature of the sample in that a non-clinical population was used. Consequently, the range of performance on the measures of depressive and anxiety symptoms were restricted with most participants scoring on the lower end of the scale. Additionally, the nature of cradling bias in itself is also skewed towards leftward cradling in a neurotypical population (e.g., Jones, 2017). Given this, regression analyses could not be employed, as findings could be an artefact of the nature of the sample. Future research should strive for larger samples that cover a broader range of performance on measures so that a normal distribution can be achieved. This will allow for more powerful statistical analyses, such as regression analyses or structural equation modelling, to be used.

Another limitation is that the sample was not clinically diagnosed with depressive and/or anxiety disorders. Self-report measures were used to determine the level of depressive and/or anxiety symptoms. Previous or current clinical diagnoses were also reported by the participants themselves. Recruiting individuals diagnosed with depressive and/or anxiety disorders would allow for a better understanding of how cradling bias might be associated with these variables. It is also important to consider the high comorbidity between depression and anxiety (Cummings, Caporino, & Kendall, 2014). This study took comorbidity and a possible interaction into account by categorising the depression and anxiety variable accordingly. However, future studies that investigate depression and anxiety should use measures that are clinically informed and allow for a possible interaction effect between high

depression and anxiety. It is also important that anxiety is more sensitively defined and measured to distinguish it from stress, which may otherwise be a confounding variable.

Additionally, this study did not take into account the effect of medication, such as anti-depressants and anxiolytics, on cradling bias. The exact influences that these medications have on the brain and its processing are not clear (Marroun, White, Verhulst, & Tiemeier, 2014; Rosenblat, Kakar, & McIntyre, 2016). In light of the fact that studies investigating cradling bias are examining brain function, it is possible that these medications could influence the results. In this study, the use of certain medications could have affected how participants scored on the depression and/or anxiety measures as well as their performance in the cradling bias task. Future studies in this field need to consider what medications participants might be using. Additionally, medication use could be investigated as a separate variable by examining cradling bias in participants with depression and medication compared to participants with depression and no medication (and the same for anxiety).

Summary and Conclusion

This study found a similar prevalence rate to previous research within the range of 65 to 85% of females (e.g., Bourne & Todd, 2004; Jones, 2017), further supporting the existence of the leftward cradling bias. While this phenomenon has been observed across cultures, time, and even in other primate species, the underlying mechanism is still not clearly understood. Early explanations put forward by the handedness and heartbeat hypothesis have not been empirically supported (Harris, 2010). The most robust explanation in the literature is based on the dominant right hemisphere functions for emotion processing as a facilitator of being able to relate to others better when their sensory cues are processed through the left sensory modalities (i.e., visual and auditory sensory information processing). This has been supported in samples where relating abilities are disrupted due to autistic traits (Fleva & Khan, 2015; Pileggi et al., 2015). Other studies have investigated the role that depression and/or anxiety might play in disrupting leftward cradling, but the results have been inconclusive.

This study aimed to provide clarity on the association between cradling bias and depressive and/or anxiety symptoms, but no significant results were found. Therefore, further research is needed to determine if depression and/or anxiety are associated with cradling side preference as well as to explore the possible association between cradling, especially to the right, and attachment. This has applied relevance to mothers with postnatal depression, major depressive disorder and/or an anxiety disorder. Until the reason behind cradling bias is clearly identified, more research is necessary to develop our understanding of why cradling bias exists and how this phenomenon is facilitated by innate mechanisms.

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Appendix A
Demographic Questionnaire

Please complete the following brief set of demographic questions.

What is your biological sex? Female / Male / Other

How old are you? ___

What year of study are you in? ___

Do you have any caregiving experience (e.g., you have a child, you look after a younger

sibling, you babysit a lot, etc.)? If yes, please elaborate. ___

Have you ever been diagnosed with a mental health disorder (e.g., autism spectrum disorder,

depression, anxiety, bipolar disorder, etc.)? If yes, please specify. _____

Appendix B
Beck Depression Inventory-II

This questionnaire consists of 21 groups of statements. Please read each group of statements carefully and then select the one statement in each group that best describes the way you have been feeling during the past two weeks, including today. If several statements in the group seem to apply equally well, select the statement with the highest number for that group. Make sure that you do not choose more than one statement for any group, including Item 16 (Changes in Sleep Pattern) and Item 18 (Changes in Appetite).

1. Sadness

0   I do not feel sad.

1   I feel sad much of the time.

2   I am sad all of the time.

3   I am so sad or unhappy that I can't stand it.

2. Pessimism

0   I am not discouraged about my future.

1   I feel more discouraged about my future than I used to be.

2   I do not expect things to work out for me.

3   I feel my future is hopeless and will only get worse.

3. Past Failure

0   I do not feel like a failure.

1   I have failed more than I should have.

2   As I look back, I see a lot of failures.

3   I feel I am a total failure as a person.

4. Loss of Pleasure

0   I get as much pleasure as I ever did from the things I enjoy.

1   I don't enjoy things as much as I used to.

2   I get very little pleasure from the things I used to enjoy.

3   I can't get any pleasure from the things I used to enjoy.

5. Guilty Feelings

0   I don't feel particularly guilty.

1   I feel guilty over many things I have done or should have done.

2   I feel quite guilty most of the time.

3   I feel guilty all of the time.

6. Punishment Feelings

0   I don't feel I am being punished.

1   I feel I may be punished.

2   I expect to be punished.

3   I feel I am being punished.

7. Self-Dislike

0   I feel the same about myself as ever.

1   I have lost confidence in myself.

2   I am disappointed in myself.

3   I dislike myself.

8. Self-Criticalness

0   I don't criticise or blame myself more than usual.

1   I am more critical of myself than I used to be.

2   I criticise myself for all my faults.

3   I blame myself for everything bad that happens.

9. Suicidal Thoughts or Wishes

0   I don't have any thoughts of killing myself.

1   I have thoughts of killing myself, but I would not carry them out.

2   I would like to kill myself.

3   I would kill myself if I had the chance.

10. Crying

0   I don't cry any more than I used to.

1   I cry more than I used to.

2   I cry over every little thing.

3   I feel like crying, but I can't.

11. Agitation

0   I am no more restless or wound up than usual.

1   I feel more restless or wound up than usual.

2   I am so restless or agitated that it's hard to stay still.

3   I am so restless or agitated that I have to keep moving or doing something.

12. Loss of Interest

0   I have not lost interest in other people or activities.

1   I am less interested in other people or things than before.

2   I have lost most of my interest in other people or things.

3   It's hard to get interested in anything.

13. Indecisiveness

0   I make decisions as well as ever.

1   I find it more difficult to make decisions than usual.

2   I have much greater difficulty in making decisions than I used to.

3   I have trouble making any decisions.

14. Worthlessness

0   I do not feel I am worthless.

1   I don't consider myself as worthwhile and useful as I used to be.

2   I feel more worthless as compared to other people.

3   I feel utterly worthless.

15. Loss of Energy

0   I have as much energy as ever.

1   I have less energy than I used to have.

2   I don't have enough energy to do very much.

3   I don't have enough energy to do anything.

16. Changes in Sleep Pattern

0   I have not experienced any change in my sleeping pattern.

1a   I sleep somewhat more than usual.

1b   I sleep somewhat less than usual.

2a   I sleep a lot more than usual.

2b   I sleep a lot less than usual.

3a   I sleep most of the day.

3b   I wake up 1-2 hours early and can't get back to sleep.

17. Irritability

0   I am no more irritable than usual.

1   I am more irritable than usual.

2   I am much more irritable than usual.

3   I am irritable all the time.

18. Changes in Appetite

0   I have not experienced any changes in my appetite

1a   My appetite is somewhat less than usual.

1b   My appetite is somewhat more than usual.

2a   My appetite is much less than usual.

2b   My appetite is much more than usual.

3a   I have no appetite at all.

3b   I crave food all the time.

19. Concentration Difficulty

0   I can concentrate as well as ever.

1   I can't concentrate as well as usual.

2   It's hard to keep my mind on anything for very long.

3   I find I can't concentrate on anything.

20. Tiredness or Fatigue

0   I am no more tired or fatigued than usual.

1   I get more tired or fatigued more easily than usual.

2   I am too tired or fatigued to do a lot of the things I used to do.

3   I am too tired or fatigued to do most things I used to do.

21. Loss of Interest in Sex

0   I have not noticed any recent change in my interest in sex.

1   I am less interested in sex than I used to be.

2   I am much less interested in sex now.

3   I have lost interest in sex completely.

Appendix C
Beck Anxiety Inventory

Below is a list of common symptoms of anxiety. Please carefully read each item in the list.
Indicate how much you have been bothered by that symptom during the past month,
including today, by selecting the appropriate response option.

	Not At All	Mildly - it didn't bother me much	Moderately – it wasn't pleasant at times	Severely – it bothered me a lot
Numbness or tingling				
Feeling hot				
Wobbliness in legs				
Unable to relax				
Fear of worst happening				
Dizzy or lightheaded				
Heart pounding/racing				
Unsteady				
Terrified or afraid				
Nervous				
Feeling of choking				
Hands trembling				
Shaky/unsteady				
Fear of losing control				
Difficulty in breathing				
Fear of dying				
Scared				
Indigestion				
Faint/lightheaded				
Face flushed				
Hot/cold sweats				

Appendix D
Edinburgh Handedness Inventory

Please indicate your preferred use of hands in the following activities by selecting the appropriate response option. Some of the activities require both hands. In these cases, the part of the task, or object, for which hand preference is wanted is indicated in brackets. Please try to answer all the questions and only leave a blank if you have no experience at all of the object or task.

	Always right	Usually right	Both equally	Usually left	Always left
Writing					
Drawing					
Throwing					
Scissors					
Toothbrush					
Knife (without fork)					
Spoon					
Broom (upper hand)					
Striking a match (match)					
Opening box (lid)					
Which foot do you prefer to kick with?					
Which eye do you use when using only one?					

Appendix E
SRPP Advertisement

Subject: Get 2 SRPP points!

Good day,

The purpose of this study is to look at the behaviour of relating to others. All **female** students are welcome to participate.

First, you can take the online survey by clicking on this link:
http://www.surveymonkey.com/r/WK5YLXR.
This should take approximately 10-15 minutes.

Then, you will be emailed to come into the UCT Department of Psychology to complete one face-to-face task and one more questionnaire. This session will take approximately 5-10 minutes.

You will receive **2 SRPP** points if you take part in both parts of the study.

This study has no associated psychological or medical risks.

If you have any queries, please feel free to get in touch.

Thank you!

Kind regards,
Simone Storey
Psychology Honours Student
strsim012@myuct.ac.za

Appendix F
Informed Consent Form

Purpose

The purpose of this research is to investigate the behaviour of relating to others by studying female students.

Procedure

If you decide to participate in this study, you will be asked to complete an online survey, containing a few short questionnaires to gather general information about your mental health. The online survey should take approximately 10-15 minutes to complete. You will then be asked to come to a session in the UCT Psychology Department to participate in a face-to-face task and to complete one more questionnaire. This session will take approximately 5-10 minutes to complete.

Possible Risks

There are no psychological or medical risks associated with taking part in this study.

Possible Benefits

If you complete both the online survey and the session task, you will receive **2 SRPP** points. You need to complete both sections of the study to receive your points.

Voluntary Participation

Your participation in this study is completely voluntary. You are free to refuse to participate without giving a reason. If you decide to participate, you are free to change your mind and withdraw from the study at any time without any negative consequences. However, you will not be awarded any SRPP points if you withdraw from the study.

Confidentiality

This study will keep your identity confidential and all research information will be stored safely. Your identity will not be linked to any data collection. Any reports or publications about this study will not identify you or any other study participant.

Questions

If you have any study-related queries or problems, you may contact Simone Storey at strsim012@myuct.ac.za.

If you have any questions about your rights as a study participant, or any comments or complaints about the study, please contact:

Rosalind Adams at the UCT Department of Psychology

Phone: 021 650 3417

Email: rosalind.adams@uct.ac.za

Informed Consent

I have read the above and am satisfied with my understanding of the study and its possible risks and benefits. Any questions I may have had about the study have been answered. I hereby voluntarily consent to participate in the study as described above.

Name of Participant: _____

Student Number: _____

Course for SRPP points: _____

Date: _____

Signature: _____ (tick box on online survey)

Appendix G
Debriefing Letter

Good day,

Earlier this year, you took part in a research study where you were required to take an online survey and come in for a face-to-face session which involved a task with a crying doll. Thank you so much for your participation!

This letter provides you with the full information about the study in which you participated because you were not made aware of all the aims at the beginning of the study.

Purpose

The purpose of this research was to investigate cradling behaviour and whether mood or handedness has an influence on this. The online survey gathered information on your mood and anxiety, while the face-to-face session allowed your cradling behaviour to be observed and to determine your handedness. The study did not find any significant associations between cradling behaviour and mood or handedness.

Deception

You were not informed about the study's true aim of investigating cradling behaviour so that this awareness would not influence how you behaved in the cradling task. You were deceived in this way because it is very important for the validity of the study that you were not affected by the study's aim.

Further Proceedings

Please feel free to contact me if you have any queries about the study. It is important to resolve any discomfort that this study may have caused.

Researcher: Simone Storey

Email: strsim012@myuct.ac.za

Supervisor: Dr Lea-Ann Pileggi

Email: lea-ann.pileggi@muct.ac.za

Alternatively, please feel free to contact UCT Student Wellness Services:

Address: Ivan Toms Building, 28 Rhodes Ave, Mowbray, Cape Town

Phone: 021 650 1017

You can also talk to a trained counsellor on the 24-hour UCT Student Careline:

Phone: 0800 24 25 26 (free from a Telkom line) or SMS: 31393 (for a call-me-back)

Other options for support are:

LifeLine – Phone: 021 461 1113

South African Depression and Anxiety Group – Phone: 0800 12 13 14

If you have any queries for the Research Ethics Committee, please contact:

Rosalind Adams at the UCT Department of Psychology

Phone: 021 650 3417

Email: rosalind.adams@uct.ac.za

Your participation is really appreciated!

Kind regards,

Simone Storey

strsim012@myuct.ac.za

Appendix H
Letter of Ethical Approval

UNIVERSITY OF CAPE TOWN

Department of Psychology

University of Cape Town Rondebosch 7701 South Africa
Telephone (021) 650 3417
Fax No. (021) 650 4104

04 June 2018

Simone Storey
Department of Psychology
University of Cape Town
Rondebosch 7701

Dear Simone

I am pleased to inform you that ethical clearance has been given by an Ethics Review Committee of the Faculty of Humanities for your study, *Examining the relationship of cradling bias with depression and anxiety in female students*. The reference number is PSY2018-031.

I wish you all the best for your study.

Yours sincerely

Lauren Wild (PhD)
Associate Professor
Chair: Ethics Review Committee

University of Cape Town
ΨPSYCHOLOGY DEPARTMENT
Upper Campus
Rondebosch