Leftward Cradling Bias is Disrupted by Depression and/ or Anxiety

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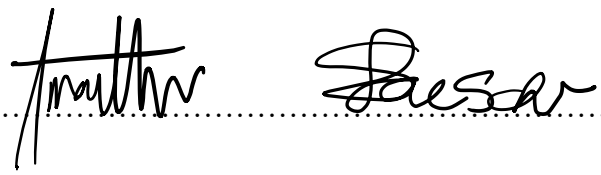
SIGNATURES ..  ……..

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Abstract

The leftward cradling bias is a universal phenomenon observed across various populations, regardless of culture, time-period, and sex. Numerous explanations have arisen to explain this phenomenon, with the cerebral laterality hypothesis receiving the most empirical support. This hypothesis posits that functions specific to the right hemisphere, namely its specialisation in social-emotional relating and facial-emotional processing, underlie the leftward cradling bias. It has furthermore been suggested that depression and anxiety interfere with right-hemisphere functions, thereby disrupting the leftward cradling bias. However, research investigating this relationship has presented inconclusive findings. The present study investigated the relationship between depression and/or anxiety and cradling side, hypothesising that depression and/or anxiety diagnoses and symptoms would disrupt the leftward cradling bias. The study consisted of 374 undergraduate students who took part in an online survey. Handedness, autistic traits, dispositional empathy, depression diagnosis, depression symptoms, anxiety diagnosis, and anxiety symptoms were measured. Of the non-clinical group, 67.84% cradled to the left, while only 45.05% of the clinical group cradled to the left. A hierarchical linear regression revealed that handedness, depression diagnosis, anxiety diagnosis and comorbid depression and anxiety diagnosis significantly predicted cradling side. Overall, findings indicated that a clinical diagnosis of depression and/or anxiety was significantly predictive of a reduced leftward cradling bias, but symptoms of the above were not, suggesting that clinically significant levels of depression and/or anxiety are necessary to disrupt leftward cradling bias. These findings lend further support to the theory that social-emotional relating plays a key role in the leftward cradling phenomenon.

Keywords: anxiety, cerebral laterality hypothesis, depression, empathy, leftward cradling bias, social-emotional relating.

Leftward cradling bias (LCB) is the phenomenon whereby humans generally prefer to cradle an infant to the left side of the body when soothing it (Harris et al., 2007). This phenomenon is seen in most adults across cultures and history and has been documented in 74% of females, and to a lesser extent, males (de Château, 1983; Harris, 2010; Packheiser et al., 2019). Several theories have attempted to explain this phenomenon, with an evolutionary theory citing lateralisation of social information processing to the right hemisphere fast gaining support (Packheiser et al., 2018). As LCB is considered a universal phenomenon, its absence or reduction in certain populations could provide insight into the mechanism facilitating this phenomenon. One such example is those affected by Autism Spectrum Disorders (ASDs), which has linked LCB to social-emotional relating, a key difficulty for those diagnosed with ASDs (Fleva & Khan, 2015; Pileggi et al., 2015). Another population that has displayed absent/reduced LCB are those affected by depressive and/or anxiety disorders (e.g., Malatesta et al., 2019; Scola et al., 2013). Findings in these latter populations are currently mixed. It is plausible that reduced/absent leftward cradling could negatively influence the parent-infant relationship and could act as a possible indicator of a parental mood disorder which has been linked to later negative social-emotional developmental outcomes in the infant (Cooper et al., 2009; Malatesta, et al., 2019).

Past and Current Theories

Early theories explaining LCB include the handedness and heartbeat hypotheses, which attempt to explain the LCB in terms of dominant hand and side of heartbeat, respectively (Huheey, 1977; Salk, 1973). Contradicting earlier findings of no association between handedness and LCB (see Harris, 2010; Jones, 2017), a recent meta-analysis found that right-handers had a significantly stronger LCB (Packheiser et al., 2019). However, only five of the 40 studies reviewed found this association, and this meta-analysis did not control for the cradling context across studies. Cradling context is determined by the operational definition of cradling and could impact results as different styles of holding entail different mechanisms. To elaborate, a mother who is comforting her child is more likely to cradle them to the left, whereas a mother who is transporting her child is more likely to use her non-dominant hand (Pileggi et al., 2015; Sieratzki & Woll, 2002). As definitions of cradling differed across studies, comparisons are compromised. The heartbeat hypothesis, on the other hand, proposes that infants are often cradled to the left, as they are soothed by the heartbeat of the cradler, which is most often strongest on the left side where the heart is positioned (Salk, 1973). However, this hypothesis lacks empirical evidence (Salk, 1973; Todd & Butterworth, 1998). Both the handedness and heartbeat hypotheses therefore lack support in the literature.

Most research supports a cerebral laterality hypothesis, which posits that LCB occurs as a result of the right hemisphere's specialisation in face and emotion processing (Bourne & Todd, 2004). Various versions of this hypothesis propose that LCB facilitates more sensitive monitoring of the infant's emotional expressions and facial signals as a result of directing attention towards the left visual field, thereby improving communication between mother-child dyads (Harris et al., 2019; Huggenberger et al., 2009). Additionally, it has been suggested that the infant also benefits from the LCB as the more expressive side of the face falls into its visual field which could help with social-emotional development (Forrester et al., 2018). Recently, the cerebral laterality hypothesis has gained traction as an evolutionary theory. Research suggests that social interactions such as cradling, hugging, emotional listening and kissing show a left side bias (Godfrey et al., 2015; Ocklenburg & Güntürkün, 2009; Ocklenburg et al., 2018; Packheiser et al., 2018). This supports the finding that the right hemisphere is more dominant in the processing of emotional information, which has been linked to the LCB.

Social-relating and Cradling Bias

A social-relational aspect to the LCB was first suggested by Weiland and Sperber (1970). In their study, they asked participants to cradle a pillow and then subsequently to cradle it as if it were an infant that needed soothing. LCB was only displayed in the latter instance, suggesting that it is elicited once a relationship is set up between the cradler and the object being cradled. Recent findings support this suggestion, linking LCB to empathy, or the ability to relate to others (Fleva & Kahn, 2015; Forrester et al., 2018; Pileggi et al., 2015). Pileggi and colleagues (2015) found that children diagnosed with ASDs displayed no cradling bias. In support, both Fleva and Khan (2015), and Herdien and colleagues (2020) found that typically developing adults measuring high in autistic traits were less likely to exhibit LCB. As deficits in empathy is a key feature of ASD, an absence of an LCB in this population further supports the link between the LCB and social-emotional relating (Hermans et al., 2009; Kanner,1943; Wing & Gould, 1979). Additionally, a significant correlation between higher social ability scores and a LCB in children has been reported, offering supplemental evidence to this theory (Forrester et al., 2018).

Mood Disorders and Cradling Bias

The proposed link between social and emotional processing and LCB implicates another population that may display a reduced LCB - those affected by mood disorders (Scola et al., 2013). Mood disorders, particularly anxiety and depression, have been shown to affect social-emotional relating which may in turn affect cradling preference (Demenescu et al., 2010; Scheuerecker et al., 2010). As early as 1960, Salk noted that, when separated from their infants

at birth, mothers tended not to hold their infants on the left when reunited (Salk, 1973). Furthermore, others have noted that expectant mothers, and mothers who cradled to the right, tended to be more anxious about the delivery and subsequent relationship with the child, and showed less sensitivity to signals given by the infant as opposed to left-cradling mothers (Bogren, 1984; de Château, 1983).

Findings linking depression to cradling bias have been mixed. To elaborate, Weatherill and colleagues (2004) showed that mothers with higher depressive symptoms displayed a decreased LCB. In support of this, another study found an association between higher depressive symptoms and a *right-holding* preference at 2 months postpartum (Scola et al., 2013). In addition, the study found that mothers with a right cradling bias (RCB) at 2 months postpartum had experienced a significant increase in their depressed mood since the prenatal period, whereas mothers who prenatally reported high depressive symptoms but had a LCB, reported decreased depressive symptoms at 2 months postpartum. More recently, two studies demonstrate a decrease in leftward cradling as depressive symptoms increased (Malatesta et al., 2019; Pileggi et al., 2020). However, while Pileggi and colleagues (2020) found a trend of decreasing leftward cradling with increasing depressive symptoms, they used a non-clinical sample and the difference across groups was not significant. The study, however, suggested that there may be a threshold of depressive symptoms that must be met for leftward cradling to be disrupted, and therefore subclinical levels of depression will not disrupt the LCB (Pileggi et al., 2020). In contrast, Reissland and colleagues (2009) found no effect of depression symptoms on cradling preference. Mixed findings are unsurprising, due to a lack of a standardised definition of cradling across studies, lack of clinical samples and small sample sizes. Additionally, as suggested earlier, a depressive symptom threshold that has not been met by non-clinical samples may add to the inconsistent findings. Overall, though, these findings could suggest that depressive symptoms disrupt LCB.

Few studies have been conducted on anxiety and LCB, with mixed findings. Scola and colleagues (2013) found no significant effect of anxiety on cradling side. Another study found that mothers who were stressed also displayed a significantly reduced LCB (Reissland et al., 2009). The same study examined the effect of comorbid depression and stress (here linked to anxiety) on cradling preference, finding no significant effect. In contrast, Vauclair and Scola (2009) showed that new mothers with ‘affective symptoms’, as measured by an anxiety and depression scale combined, were less likely to display a LCB when compared to the control group, raising the question of whether comorbid mood disorders do, in fact, have a combined

effect on cradling preference. Similarly to above, mixed findings could be due to inconsistent definitions of cradling and anxiety, small sample size and lack of clinical samples.

Notably, a recent study investigated LCB in a township in South Africa where the average stress and depression of the population are reported high (Morgan et al., 2018). Within this population, equal instances of leftward, rightward and no cradling preference were found, contradicting the otherwise universal prevalence of LCB. There was also no evidence of a relationship between cradling preference and depression, but a strong association between high stress and no cradling preference. The authors speculated that this was linked to adverse living conditions and the need to preserve emotional resources.

Aims, Rationale and Hypotheses

There is a paucity of research on the relationship between depression, anxiety and LCB. The research that does exist has produced varying results due to small sample size, the absence of clinical samples, and inconsistencies in operational definitions of variables. Continued research in this area is important, as the clarification of the relationship between mood disorders and cradling bias could be useful in achieving a more nuanced understanding of the mechanism underlying this universal leftwards bias. In particular, further research investigating the relationship between depression/anxiety, empathy and cradling bias could elucidate this mechanism. Further research employing a clinical sample could contribute to findings linking depression and/or anxiety to a disrupted LCB, in that such a sample is more likely to meet a symptom threshold, and therefore return significant results. Additionally, a non-leftward cradling bias could be an indication of possible mood disorder, potentially leading to emotional disengagement by the parent from their infant, which has been shown to have negative implications for the infant's development, such as an insecure attachment style (Cooper et al., 2009). If, as Scola and colleagues (2013) suggest, a rightward or reduced leftward cradling bias could be a predictor of later increases in depressed mood, it is possible that cradling preference can be used as a screening procedure for parental depression interventions. Lastly, if research into LCB continues to support the link between social-emotional relatedness and leftward cradling, it is possible that the LCB could benefit the child in terms of the development of cognitive and social-relational abilities and a leftward hold should be recommended to new parents (Malatesta et al., 2020; Malatesta, et al., 2019; Vervloed et al., 2011).

Therefore, this study addressed the question whether mood disorders, namely depression and anxiety, reduce/disrupt LCB. We did so by using clear operational definitions, recruiting clinical and non-clinical samples, and recruiting a sample size large enough to ensure robust statistical analyses. Our hypotheses were as follows:

H_1: There will be an association between depression and LCB in that (1) higher depressive scores will be associated with a reduced LCB and (2) a diagnosis of depression will be associated with a reduced LCB.

$H_{2:}$ There will be an association between anxiety and LCB in that (1) higher anxiety scores will be associated with a reduced LCB and (2) a diagnosis of anxiety will be associated with a reduced LCB.

H_3: Comorbid anxiety and depression will be associated with LCB in that (1) combined high score in depression and anxiety scores will be associated with decreased leftward cradling and (2) a combined diagnosis of anxiety disorder and depressive disorders will be associated with a reduced LCB.

H_4: Lower empathy scores will be associated with a reduced LCB.

Method

Design and Setting

This study utilised a cross-sectional, correlational design to examine the relationship between several variables, namely dispositional empathy, depressive symptoms, symptoms of anxiety, as well as clinical diagnoses of depression and anxiety, and LCB. Additionally, gender, handedness and autistic traits were considered as confound controls. All data were collected online.

Participants

Three hundred and seventy-four undergraduate psychology students (320 female, 53 male, 1 non-binary, 1 trans-woman) from the University of Cape Town (UCT) participated in this study. All participants were aged 18 years and above and were recruited via convenience sampling by means of an electronic invitation sent out by the UCT Psychology Department's Student Research Participation Programme (SRPP; Appendix A).

Eligibility Criteria

Individuals diagnosed with Autism Spectrum Disorder were excluded from our sample, given findings linking autistic traits to LCB (Fleva & Kahn, 2015; Pileggi et al., 2015). Additionally, those who reported a history of social disorders, such as oppositional defiant disorder, were excluded as this would influence findings given associations of such disorders with callous unemotional traits and decreased empathy (see de Wied et al., 2010). Individuals who are parents were also excluded, as previous studies have suggested that infant-holding experience increases LCB (de Château et al., 1982).

Measures

Screening Questionnaire

Participants completed a screening questionnaire to determine their eligibility to participate in the study (Appendix B). This questionnaire garnered participants' demographic information, including information regarding neurological or psychiatric conditions, any medication the participant might be taking, and also previous child-rearing experience.

Edinburgh Handedness Inventory (EHI)

The EHI (Oldfield, 1971) was used to determine participants' hand dominance (Appendix C). The EHI consists of 20 items asking which hand is preferred to use when conducting everyday activities such as brushing teeth. Each item can be answered as 'always right', 'usually right', 'both', 'usually left', and 'always left'. This test is well-established, and often used in cradling bias studies (Morgan et al., 2018; Scola et al., 2013). Laterality Quotients (LQ) range from –100 (always left) to 100 (always right), when performing a particular task. To calculate the LQ, scores were added and divided by total number of items. Handedness was categorised as Left = -100 to -61, Mixed = -60 to 60 and Right = 61 to 100.

The EHI is a widely used measure that has demonstrated good test-retest reliability (Edlin et al., 2015). It has also been used previously for studies in South Africa (Kopiez et al., 2011; Morgan et al., 2018), although its psychometric properties here are still unknown.

Autism Spectrum Quotient (AQ)

We used the AQ to measure autistic traits (Appendix D). The AQ is a short, self-administrable tool that measures the level of autistic traits present in neurotypical adults (Baron-Cohen et al., 2001). Comprising 50 questions, each set of 10 questions assesses one of 5 areas associated with abnormalities in ASDs, namely social skills, attention switching, attention to detail, communication, and imagination. Responses were scored on a 4-point Likert scale with options ranging from 'definitely agree' to 'definitely disagree' (Baron-Cohen et al., 2001). The final total score ranges between 0 and 50, with higher scores indicating higher levels of autistic traits.

The AQ has yielded excellent test-retest reliability and reasonable construct validity by its authors (Baron-Cohen et al., 2001; Baron-Cohen et al., 2006). It has also yielded good psychometric properties across cultures in Dutch, Japanese, and British samples (Hoekstra et al., 2008; Wakabayashi et al., 2006). While the AQ has been used in South African studies, its psychometric properties have not been ascertained (Herdien et al., 2020).

Cradling Bias Task

We used a self-reported imagined cradling bias task, a method often utilised in cradling bias research. The bias was recorded across four separate trials. An instance of leftward cradling was coded as –1, while an instance of rightward cradling as 1, with a final score ranging between –4 (indicating a strong left bias) and 4 (indicating a strong right bias). Negative values were interpreted as a leftward bias, 0 indicated no bias, and positive values were interpreted as rightward bias.

For each trial, the task proceeded as follows: a behavioural prompt accompanied by a cradling position demonstration appeared on the computer screen (Appendix E). The participant was then required to select to which side they looked in response to this prompt. The prompt read:

> Imagine that you are holding a small infant in your arms. Try to imagine the infant's face, eyes, mouth, body, and arms. Now position your arms as if you were gently soothing the infant or putting it to sleep. Turn your head to look at the infant's face. To which side are you looking? To your left or right side? (Pileggi et al., 2013, p. 57)

Questionnaire of Cognitive and Affective Empathy (QCAE)

The QCAE (Appendix F) was used to measure dispositional empathy. It is a self-report measure with both cognitive and affective components (Reniers et al., 2011). Cognitive empathy is the ability to understand another's emotional state, while affective empathy is the ability to share emotions with another (Lockwood et al., 2014).

The QCAE consists of five subtests – two assessing cognitive empathy and three assessing affective empathy, totalling 31 items (Reniers et al., 2011). Items were rated on a 4-point Likert scale, ranging from 'definitely disagree' (1) to 'definitely agree' (4). Scores for cognitive and affective empathy were added together to obtain a final dispositional empathy score. Higher scores are interpreted as having greater dispositional empathy.

The QCAE has shown good convergent and construct validity (Reniers et al., 2011). While it has not been used in any published work, it has been shown to be a reliable and valid measure of dispositional, cognitive and affective empathy in South Africa in theses and dissertations (Gilli, 2016; Louw, 2014; Ringshaw, 2015).

Beck Depression Inventory-II (BDI-II)

We used the BDI-II to measure the presence and severity of depressive symptomology (Beck et al., 1996; Appendix G). The BDI-II is a widely used measure of depressive symptoms based on the DSM-IV criteria for major depressive disorder. The 21 items measure three symptom clusters, namely negative attitude, performance difficulty, and somatic elements.

Each item is measured on a 4-point Likert scale ranging from 0 to 3 based on the severity of the symptom. For example, the item examining sadness reads: (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. Higher scores indicate more severe symptoms of depression. In non-clinical populations, a score of above 20 suggests depression (Beck et al., 1996).

The BDI-II has demonstrated high reliability and validity and can be used effectively in both clinical and non-clinical populations (Jackson-Koku, 2016). It has furthermore demonstrated reliability in environments of diverse ethnicity, and has been used successfully in a South African context to measure symptoms of depression (Carmody, 2005; Kagee et al., 2014).

State-Trait Anxiety Inventory (STAI)

We used the STAI to assess participants' anxiety level (Spielberger, 1983; Appendix H). This test consists of two versions which look at both current (A-state), and dispositional (A-trait) states of anxiety. The A-state subscale was used for this study as its purpose is to assess the anxious state of individuals in the present moment (Kvaal et al., 2001). The A-state has a cut-off score of above 39 for clinically significant symptoms, and has been found to have good reliability and validity (Barnes et al., 2002; Kvaal et al., 2001). The STAI is a self-report measure, in Likert scale format. For example, a question will state: 'I feel calm', with response options ranging from 'not at all' to 'very much so'.

It is a reliable and valid measure of anxiety (Metzger, 1976) and has demonstrated good psychometric properties internationally (Fonseca-Pedrero et al., 2012; Spielberger, 1983), but while it has been used in South Africa (Jordaan et al., 2007), its psychometric properties here are still unknown.

Procedure

Potential participants were contacted via UCT's SRPP site. Each session started by informing participants about the study and required consent before continuing. If participants provided their consent to participate (Appendix I), they completed the screening questionnaire. If participants were not found eligible, they were thanked for their time and the session was ended.

If eligible, participants were allowed to continue. The session began with the BDI-II, followed by the first cradling bias trial, the STAI, then the second cradling bias trial, the AQ, the third cradling bias trial, the QCAE, the fourth cradling bias trial, and finally the EHI. They were then thanked and given contact details for mental health support if needed. This session took participants approximately 30 minutes.

Data Management and Statistical Analyses

We used RStudio version 3.6.2 to run statistical analyses. Significance levels were set at $\alpha = 0.05$. We used hierarchical linear multiple regression analysis. We ensured that our data upheld all test assumptions. For the purpose of descriptive statistics and chi-squared tests, cradling bias and handedness were coded as categorical variables (i.e., Left or Not Left and Right, Mixed, Left respectively).

We measured 9 variables: handedness, autistic traits, dispositional empathy, depressive symptoms, anxiety symptoms, and the interaction between these, as well as depression diagnoses, anxiety diagnoses, and the interaction between these. Handedness, sex and autistic traits were investigated as potential confounds. We examined an outcome of cradling bias along the following sequence: Handedness, autistic traits, dispositional empathy, depressive symptoms and anxiety symptoms, and the interaction between these, as well as depression diagnoses, anxiety diagnoses, and the interaction between these.

Ethical Considerations

We were granted ethical approval by the UCT Psychology Department's Research Ethics Committee (Appendix J). Participants were briefed on the research aims and study procedures and asked for their consent. They were then told that the study would be investigating sex differences in facial recognition, to prevent potential confounds and biases. It was made clear that they could withdraw from the study with no negative consequences. After their session, participants were debriefed (Appendix K). All participant information was kept confidential.

It is important to note that we were dealing with a potentially sensitive group of individuals, as our variables of particular interest were depression and anxiety. Therefore, participants were given the contact details for various sources of support should they have felt this was required after completing the study, but no feedback on questionnaire results (specifically the BDI and STAI) was given to participants.

There were no known risks associated with any of the proposed research measures or procedures. Psychology students were awarded 3 SRPP points for their full participation. Points were awarded for future courses, due to the global pandemic.

Results

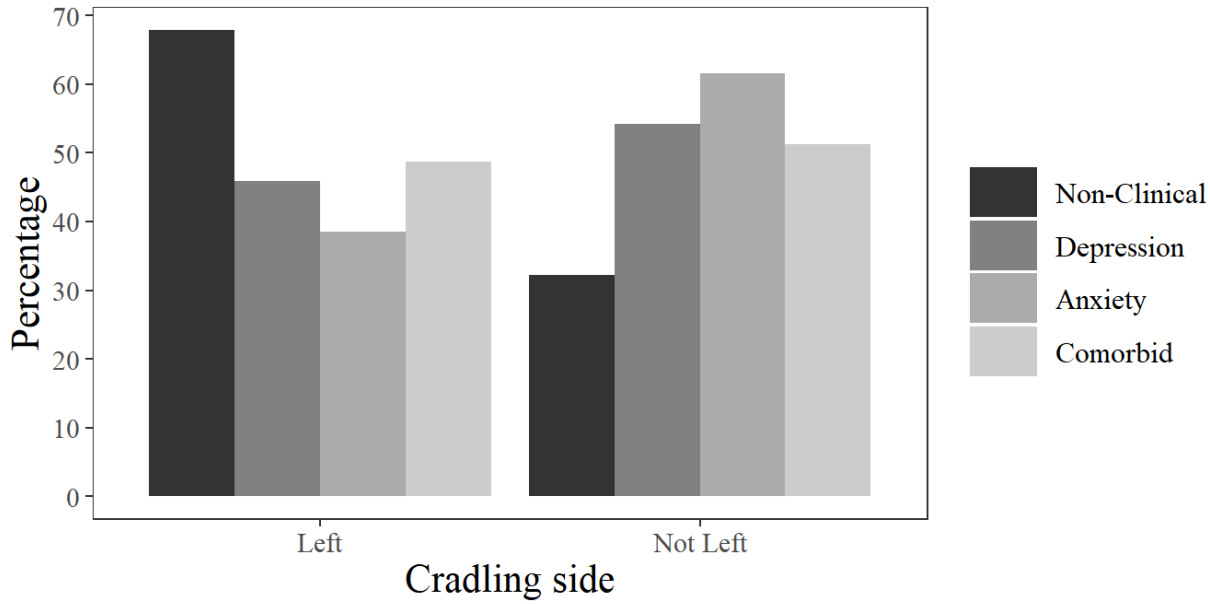
Descriptive Statistics

A total of 374 participants (319 female, 53 male, 2 other) between the ages of 18 and 41 years (M = 19.54 SD = 2.37) completed this study. Overall, 62.30% of the participants

cradled to the left. Participants were divided into a non-clinical group (*n* = 283) and a clinical group (*n* = 91). The clinical group was further divided into three groups: those who reported a clinical diagnosis of depression only (*n* = 24), anxiety only (*n* = 26) or comorbid depression and anxiety (*n* = 41). In the non-clinical group, 67.84% cradled to the left, while only 45.05% of the clinical group cradled to the left (Fig.1). LCB was absent in all clinical subgroups, with fewer than half of participants in each group cradling to the left (depression only group = 45.83%; anxiety only group = 38.46%; comorbid anxiety and depression diagnoses = 48.78%; see Figure 1).

Figure 1

Cradling Side by Group



Descriptive statistics are presented in Table 1. As can be seen, the majority of participants self-classified as female (85.29%; *n* = 319) and were right-handed (78.07%; *n* = 292). The distribution of handedness scores was therefore skewed to the left, as expected in a typically developing sample (Christman, 2012). Similarly, as is expected, autistic traits were normally distributed (*M* = 19.44; *SD* = 5.45; Baron-Cohen et al., 2001; Hurst et al., 2007). Dispositional empathy scores were slightly skewed to the left (*M* = 89.60 and *SD* = 6.62).

Table 1

Descriptive Statistics and Results Across Sex and Overall

Variable	Group		
	Overall (*n*=374)	Male (*n*=53)	Female (*n*=319)
Age			
Range (years)	18-41	18-36	18-41
M (*SD*) (years)	19.54 (2.37)	19.96 (2.98)	19.48 (2.25)
Handedness [a]			
Right: Mixed: Left	292: 67: 15	42: 10: 1	248: 57: 14
Autism Quotient			
M (*SD*)	19.44 (5.45)	17.92 (4.77)	19.71 (5.53)
Dispositional Empathy			
M (*SD*)	89.60 (6.62)	89.85 (6.67)	89.58 (6.64)
Depression Score			
M (*SD*)	14.64 (9.44)	12.68 (9.38)	14.92 (9.43)
A-state Score [b]			
M (*SD*)	42.85(12.78)	40.75 (11)	43.19 (13.06)

Note. Two participants identified their sex as "Other". These were excluded in calculating numbers for male and female but included in overall.

[a] Measured on the Edinburgh Handedness Inventory (Oldfield, 1971), Left = -100 to -61, Mixed = -60 to - 60, Right = 61 to 100 [b] Measured on the state subscale of the State Trait Anxiety Inventory (Spielberger, 1983)

The BDI was used to measure depressive symptoms with a threshold of >20 indicating clinically significant symptoms. Overall, 21.12% of participants met the threshold for clinically significant depressive symptoms (n = 79) according to the BDI, while only 17.38% (n = 65) of participants reported a depression diagnosis. Data was skewed to the right (M = 14.64, SD = 9.44). This distribution is similar to those found in other samples of university students (Georgieva et al., 2020; Whisman & Richardson, 2015).

The A-state subscale of the STAI was used to measure current anxiety symptoms with a threshold of >39 indicating clinically significant symptoms. Data was slightly skewed to the right (M = 42.85; SD = 12.78). These numbers are higher than previously reported Western norms (Crawford et al., 2011; Iwata & Higuchi, 2000). Overall, 56.68% of participants met the threshold for clinically significant anxiety symptoms (n = 212) according to the STAI, while only 17.91% (n = 67) of our sample reported an anxiety diagnosis. Of our entire sample, 10.96% reported a previous diagnosis of depression and anxiety disorder (i.e., comorbid diagnosis; n = 41), while 18.45% (n = 69) met the threshold for both clinically significant depressive and anxiety symptoms on the BDI and STAI.

Regarding sex, 63.01% of females cradled to the left, compared to 58.49% of males. A chi-square contingency test indicated that cradling side was not contingent on sex, χ^2 (1, N = 372) = .23, p = .634. In terms of handedness, 64.73% of right-handers, 58.21% of mixed handers and 27.78% of left-handers cradled to the left. A chi-squared test of independence indicated that cradling side was contingent on handedness, χ^2 (2, N = 374) = 6.57, p = .037.

Regression Analysis

Hierarchical multiple regression analysis was conducted to examine the relationships between cradling bias and several potential predictors. Of particular interest was the predictive significance of depression, anxiety, and comorbid diagnoses on cradling bias. We were also interested in the role of empathy in predicting cradling bias. The hierarchical sequence was informed predominantly by previous literature. Variables that did not add significant change in explanation were excluded from further steps in the model.

We started with our confound variables of Handedness, Sex, and Autism Quotient as recent research suggests these have an association with the LCB (Fleva & Kahn, 2015; Packheiser et al., 2019; Pileggi et al., 2015). In steps 1 and 2, we entered Handedness and Autism Quotient, respectively. We omitted Sex from the model, as our preliminary analysis indicated that cradling side was not contingent on Sex. While the literature suggests some predictive power for Sex, it also indicates that a leftward bias exists across Sex.

We then entered variables of interest. In Step 3, we added Dispositional Empathy, using a combined score of Cognitive and Affective Empathy, due to (1) multicollinearity and (2) both being noted as potential predictors of cradling side (Forrester et al., 2018; Pileggi et al., 2015). Next, we added depression and anxiety variables, each in their own step: In Step 4, we added a combined variable of Depression Diagnosis and BDI Score, and in Step 5, a combined variable of Anxiety Diagnosis and A-state Scores. These variables were combined, as one would expect an association between the diagnosis and its respective symptoms. Lastly, a

combined variable of Comorbid Diagnosis, A-state score and BDI score was entered as we were also interested in the effect of the interaction of depression and anxiety on cradling side.

Diagnostics were conducted on our initial model to check assumptions were upheld. Our initial model suffered from heteroscedasticity of variance and it was found that participant 327 was exerting undue influence on the model according to a test of Cook's distance. On examination, it appeared that although this participant was in the comorbid group, they had an unusually low A-state score. As a result, and due to our relatively large sample size, we decided to remove this participant and rerun the model. The second model upheld assumptions.

Intercorrelations between Cradling Quotient and potential predictors can be seen in Table 2. There were significant zero-order correlations between Cradling Quotient and Handedness, Depression Diagnosis, Anxiety Diagnosis and Comorbid Diagnosis (with $p < .05$). There were also some significant correlations between predictor variables. However, multicollinearity was not detected in the model.

Table 2

Intercorrelations Between Cradling Quotient and Potential Predictors

	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Cradling Quotient	1	-.26***	.01	.06	.11*	.02	.12*	-.02	.11*
2. Handedness [a]		1	-.02	.04	-.04	-.01	0	.04	.10
3. Autism Quotient			1	-.07	-.02	.4***	-.04	.28***	.06
4. Dispositional Empathy [b]				1	-.03	.01	.07	.02	.07
5. Depression Diagnosis					1	.01	-.07	-.04	-.09
6. Beck Depression Inventory						1	-.01	.64***	.26***
7. Anxiety Diagnosis							1	.01	-.09
8. A-state [c]								1	.13**
9. Comorbid Diagnosis									1

[a] Scores taken from the Edinburgh Handedness Inventory. [b] Scores taken from Questionnaire of Cognitive and Affective Empathy [c] Scores taken from the State Trait Anxiety Inventory (Spielberger, 1983). A higher score indicates better performance.

* $p < .05$. ** $p < .01$. *** $p < .001$.

A summary of the steps in the regression analysis are presented in Table 3. In Step 1, we investigated whether Handedness predicted Cradling Quotient. This model was significant, F (1, 372) = 23.09, p<.001, R^2 = .06, *Adjusted* R^2 = .06, with Handedness explaining 6% of the variance in Cradling Quotient scores. In Step 2, AQ Score was added. While the model was significant, AQ score did not contribute significantly to the model (t =.03, p = .977), and so was excluded from further steps. QCAE Score was added in Step 3. This model was significant, but the predictor also did not contribute significantly (t = 1.4, p = .163). As a result, AQ score was excluded from the following steps.

A combined variable of Depression Diagnosis and BDI Score was added in Step 4. This model was significant, F (3, 370) = 9.17, p <.001, R^2 = .07, *Adjusted* R^2 = .06, ΔR^2 = .01, with this variable yielding a 1% change in explained variance. On closer examination, only Depression Diagnosis returned a significant t-value. Additionally, from the intercorrelation matrix, we see that counter-intuitively, Depression Diagnosis and BDI Score were not correlated. Consequently, we removed BDI Score from this step.

In Step 5, a combined variable of Anxiety Diagnosis and A-state Score was introduced. The model was significant F (4,369) = 8.65, p <.001, R^2 = .09, *Adjusted* R^2 = .08, ΔR^2 = .02. This variable yielded a 2% increase in explained variance. However, only Anxiety Diagnosis had a significant effect on the model (t-value p <0.05). Similarly to above, Anxiety Diagnosis and A-State Score were not correlated. Consequently, A-state Score was removed from this step.

In Step 6, a combined variable of Comorbid Diagnosis, BDI Score and A-State Score was added. Once again, this model was significant, F (6, 367) = 7.16, p<.001, R^2 = .11, *Adjusted* R^2 = .09, ΔR^2 = .02, with this variable contributing a further 2% change in explained variance. Again, Comorbid Diagnosis was the only significant contributor. Interestingly, both BDI Score and A-State score were significantly correlated with Comorbid Diagnosis. However, both BDI Score and A-State Score came back as non-significant and were therefore excluded from the final model.

Lastly, a final model was computed with only significant predictors included. These were: Handedness, Depression Diagnosis, Anxiety Diagnosis and Comorbid Diagnosis. This final model was significant, F (4, 369) = 10.77, p<0.001, R^2 = .11, *Adjusted* R^2 = .10. Overall, results indicated that Handedness, Depression Diagnosis, Anxiety Diagnosis and Comorbid Diagnosis significantly predicted Cradling Quotient with b-values showing that Handedness (b = -.25*)* was the strongest predictor, then Anxiety Diagnosis (b = .14*)*, Comorbid Diagnosis (b

= .14*)* and finally Depression Diagnosis (*b* = .13). Overall, the final model was able to predict 11% of the total variance in cradling side.

Table 3
Summary of Steps 1-7 Regression Analyses

	B	*b*	SE	*t*	VIF	*F*	R^2	ΔR^2	*Adjusted* R^2
Step 1						23.09*	.06	.06	.06
Handedness	-.02	-.24	0	-4.81*	1				
Step 2						11.52*	.06	0	.05
Handedness	-.02	-.024	0	-4.8*	1				
Autism Quotient	0	0	0.30	0.03	1				
Step 3						12.55*	.06	0	.06
Handedness	-.02	-.24	0	-4.86*	1				
Dispositional Empathy	.03	.07	.02	1.40	1				
Step 4						9.17*	.07	.01	.06
Handedness	-.02	-.24	0	-4.75*	1				
Depression Diagnosis	1.28	.10	.63	2.03*	1				
BDI Score	.01	.02	.02	.70	1				
Step 5						8.65*	.09	.02	.08
Handedness	-.02	-.24	0	-4.77*	1				
Depression Diagnosis	1.40	.11	.63	2.23*	1.01				
Anxiety Diagnosis	1.57	.13	.60	2.61*	1.01				
A-state Score	0	0	.01	.03	1.01				
Step 6						7.16*	.11	.02	.09
Handedness	-.02	-.25	0	-4.96*	1.01				
Depression Diagnosis	1.56	.13	.63	2.50*	1.02				
Anxiety Diagnosis	1.75	.15	.60	2.91*	1.02				
Comorbid Diagnosis	1.40	.14	.51	2.75*	1.10				
BDI Score	0	-.01	.02	-.14	1.81				
A-state Score	0	-.01	.02	-.14	1.72				
Step 7						10.77*	.11	.02	.10
Handedness	-.02	-.25	0	-4.99*	1.01				
Depression Diagnosis	1.56	.13	.62	2.51*	1.02				
Anxiety Diagnosis	1.75	.14	.60	2.91*	1.02				
Comorbid Diagnosis	1.37	.14	.49	2.79*	1.02				

*p<.05.

Discussion

This study investigated whether depression and/or anxiety disrupts LCB in a sample of university students. In keeping with previous findings, the majority of our sample (62.3%) cradled to the left (Packheiser et al., 2019). This number is lower than the 74% preference for LCB, but this is to be expected as we included a clinical subgroup, which we expected would

reduce LCB. In our non-clinical group alone, the percentage of left cradlers increased to 67.84%, a number more in keeping with findings in the general population. In contrast, we found that a diagnosis of depression, anxiety, or both was associated with reduced LCB. Less than half of each of our clinical subgroups cradled to the left, with 45.83% of the depression only group, 38.46% of the anxiety only group, and 48.78% of the comorbid only group cradling to the left. We were also interested in the relationship between dispositional empathy and LCB. Contrary to expectations, we did not find a relationship between these two variables.

The LCB has proven to be a universal phenomenon with very few exceptions (see Harris et al., 2010; Jones, 2017; Packheiser et al., 2019). Recent research has found that one exception is those with ASD, or high autistic traits, who display a reduced or absent LCB (Fleva & Kahn,2015; Herdien et al., 2020; Pileggi et al., 2015). The only other exception suggested by literature to date has been the population affected by mood disorders such as depression or anxiety (Malatesta et al., 2019; Pileggi et al., 2020; Reissland et al., 2009; Scola et al., 2013; Vauclair & Scola, 2009; Weatherill et al., 2004). While there has been some indication in the literature that depression and/or anxiety may disrupt the LCB, findings have been mixed at best, with small sample sizes, unclear operational definitions and predominantly non-clinical samples being used. Ours is the first study of which we are aware to find a clear influence of clinical diagnosis of depression and/or anxiety on cradling side, using both clinical and non-clinical samples, clearly defined variables and a large sample size. The absence of LCB in a clinical sample with depression and/or anxiety could serve to highlight new aspects of the mechanism underlying the LCB and lends support to the social-emotional aspect of the cerebral laterality hypothesis.

Depression, Anxiety, Empathy and Cradling Side

Overall, only 45.05% of our clinical sample cradled to the left, as opposed to 67.84% of our non-clinical group, suggesting that a diagnosis of Depression and/or Anxiety is associated with reduced LCB. Indeed, we found that Depression, Anxiety and Comorbid diagnosis significantly predicted cradling side. Anxiety was the largest predictor of cradling side, followed by Comorbid diagnosis and then Depression diagnosis. This finding lends support to previous studies that have found a reduced LCB in participants with depressive symptoms, or simultaneously occurring anxiety and depression symptoms (Vauclair & Scola, 2009; Weatherill et al., 2004). In contrast, a South African study found no association between clinically significant depressive symptoms and cradling side amongst mothers living in adverse conditions (Morgan et al., 2018). However, this study did not use clinical diagnoses of

depression, but rather a measure that may not be sensitive enough to diagnose depression. Ours is the first study to include a clinical sample with diagnoses of Depression and/or Anxiety, and so is the first study to display these findings.

Notably, results did not support expectations that depressive and/or anxiety symptoms alone (i.e., not necessarily a clinical diagnosis) would be related to LCB. Neither BDI score, A-state score or a combination of the two were significant contributors to predicting cradling side. In agreement with this, Reissland and colleagues (2009), and Morgan and colleagues (2018) found no effect of depressive symptoms on cradling preference, while Scola and colleagues (2013) found the same for anxiety symptoms. Additionally, Pileggi and colleagues (2020) found a trend in decreasing LCB with increasing depressive symptoms, suggesting that there may be a threshold (i.e., severity) at which point depressive symptoms may disrupt LCB (i.e., clinical significance). Overall, these findings and ours support the notion of a threshold theory, where a point of severity in symptoms must be reached before LCB is disrupted.

Furthermore, counterintuitively, in our data no correlation was found between Depression and Anxiety diagnosis and BDI or A-state score respectively. This may support the notion that neither the BDI nor the STAI are designed as diagnostic tools, but rather are specifically for research purposes (Kabacoff et al.,1997; Peirson & Heuchert, 2001). It is further possible that a diagnosis by a clinical professional is more sensitive to this point of severity and thus is more likely to predict disrupted cradling (Marton et al.,1991).

The cerebral laterality hypothesis has posited a connection between empathy and cradling side. To elaborate, the LCB has been attributed to the right hemisphere's dominance in face and social-emotional processing, which is essential to empathic processes (Besel & Yuille, 2010; Bourne & Todd, 2004). Both anxiety and major depression have been shown to negatively affect recognition of emotional facial expression (Demenescu et al., 2010). Furthermore, mood disorders such as anxiety and depression contribute to impaired functioning of parental neuroendocrine systems, such as the one linked to parental response to baby-cry (Swain et al., 2011). In agreement, an association between depression and a reduced right posterior hemispheric activation, which negatively affects attention, has been noted (see Weatherill et al., 2014). This may lead to reduced arousal and leftward attentional shift when an infant cries. Anxiety has also been shown to affect emotional facial processing, affective empathy, and affective regulation. Highly socially anxious individuals show an attentional bias away from emotional faces, and are less able to share in others' emotions (Mansell et al., 1999, Morrison et al., 2016). Furthermore, Choi and colleagues (2012) found a negative relationship

between state anxiety scores and responses in the pre-frontal cortex and right thalamus, reflecting a reduced ability in high-anxious individuals to regulate affective responses. The above findings could explain a reduced LCB if the cerebral laterality hypothesis and its link to empathy is considered. Individuals with depression and/or anxiety may have a reduced recognition of emotions in their infants, and a reduced ability to respond to said emotion. As noted by de Château (1983), this may lead to reduced desire for emotional involvement with the infant and hence to a non-left hold.

Contrary to our hypothesis, we found that dispositional empathy was not predictive of cradling side. Little research has been conducted on the direct relationship between empathy and the LCB. Of the research that does exist, counter to our finding, Fleva and Kahn (2015) found that left cradling was associated with higher empathy scores. It has also been suggested that higher social ability scores, related to cognitive empathy, were associated with LCB (Forrester et al., 2018). However, Pileggi and colleagues (2015) theorised that more basic processes such as affective, rather than cognitive, empathy is responsible for the LCB. Our non-significant finding therefore may be due to our use of a combined cognitive and affective empathy score to indicate dispositional empathy. It is possible that, as Pileggi and colleagues (2015) suggested, only affective empathy predicts cradling side, and that individual effects of either cognitive or affective empathy were lost by grouping them together.

Handedness, Sex, Autistic Traits and Cradling Side

Unexpectedly, we found that handedness was the strongest predictor of cradling side. While this finding is in keeping with a recent meta-analysis (Packheiser et al., 2019), results contradict numerous studies which have found no association between handedness and cradling side (e.g., Donnot, 2007; Forrester et al., 2018; Harris et al., 2000; Scola & Vauclair, 2010; Vauclair & Scola, 2009; Weatherill et al., 2004). As our study used a soothing prompt, we expected to find that handedness would not predict cradling side. Importantly, it is possible that the relationship between handedness and cradling side we found is an artifact of the majority of our participants cradling to the left (62.30%) and the majority of our participants being right-handed (78.07%). It is also, however, possible that handedness plays a larger role than previously suggested. Further research is therefore needed due to the mixed nature of findings in this area.

In accordance with expectations, cradling side was not contingent on sex. In support of this finding, Herdien and colleagues (2020) found an equivalent percentage of LCB in males to that reported in females. Other studies that have found a LCB in men, albeit to a lesser extent

than women, include de Château (1983), Harris and colleagues (2001), and Packheiser and colleagues (2019). The LCB has mainly been investigated in female samples, possibly explaining significant findings of sex on cradling side. It should further be noted that our sample had disproportionately fewer males than females, although this should not have affected our results.

We found that autistic traits were not predictive of cradling side. This contrasts with previous findings that have shown higher autistic traits to be associated with a reduced leftward bias (Fleva & Kahn, 2015; Herdien et al., 2020; Pileggi et al., 2013; Pileggi et al., 2015). However, three of these studies investigated a sample that were specifically selected for autistic traits (i.e., clinical threshold met), while Herdien and colleagues (2020) dealt with an all-male sample, who may have displayed higher autistic traits due to the well-known bias of ASDs towards males (Bryson & Smith, 1998; Fombonne, 2005; Tidmarsh & Volkmar, 2003). Conversely, we dealt with a typically developing sample consisting predominantly of females. This could account for a lack of association between autistic traits and cradling side in this study.

Implications of Findings

This is the first study to find such clear associations between diagnosis of anxiety and/or depression and a reduced LCB. This finding suggests that depression and anxiety need to be present at clinically significant levels to disrupt the LCB. Our findings further contribute to the literature suggesting a link between depression and/or anxiety and a disrupted LCB, lending further support to the cerebral laterality hypothesis. In addition, a statistically significant link between diagnoses of depression and/or anxiety could act as a basis to further understand the mechanisms which underlie the universal LCB. Our findings, if further supported, could also have wider implications. Our results could suggest that parents who are clinically depressed and/or anxious may be more likely to exhibit a non-left cradling bias. Therefore, if as has been suggested, the LCB facilitates the development of typical cognitive and social-relational abilities, then it is possible that infants with clinically depressed or anxious parents may be at a developmental disadvantage, and intervention may be necessary. Moreover, if depression and/or anxiety is predictive of a non-left bias, it is possible that the relationship may go the other way (Scola et al., 2013), and that a non-left hold may indicate parental anxiety or depression. Given the well-known negative consequences of parental mood disorders on the child, a non-typical cradling side could be used as an indication of possible parental depression

and/or anxiety and the appropriate steps then taken (Cooper et al., 2009; Lindhout et al., 2006; Malatesta et al., 2019).

Limitations and Suggestions for Further Research

The current study had some limitation. Firstly, it is possible that our data suffered from response bias, which is particularly prominent in self-report measures, of which our study consisted in its entirety. Secondly, we were unable to control for hemispheric lateralisation or child-minding experience, both of which have been considered possible confounds (Bourne & Todd, 2004; de Château, 1983; Huggenberger et al., 2009). Thirdly, our clinical samples were small in comparison to our overall sample, although large enough to draw statistically significant conclusions. Fourthly, we were aware that many of our participants were on medication, although we were unable to control for the effects of this. Lastly, a number of our participants reported other comorbid diagnoses such as ADHD, Bipolar disorder and PTSD which may have affected results.

Future studies should further investigate clinical samples with larger sample sizes, while controlling for child-minding experience, hemispheric lateralisation, comorbidities and medication. Furthermore, the link between empathy and cradling bias, as well as empathy and mood disorders, should be explored in more detail as it is possible that empathy is a common factor linking mood disorders to a disrupted LCB. More sensitive measures, such as physiological measures of empathy, should therefore be incorporated. More research is also needed as to why depression and anxiety may disrupt LCB, as well as to the effect of combined depression and anxiety and why this combination may be particularly disruptive. In order to address mixed findings, future research addressing non-functional cradling and handedness, as well as cradling and sex would be beneficial. Additionally, further investigation of whether a non-left cradling bias may indicate depression and/or anxiety would be a valuable contribution to the field.

Conclusion

This study aimed to address the question of whether depression and/or anxiety disrupts the LCB. We found that a clinical diagnosis of depression and/or anxiety was significantly predictive of a reduced LCB, but that symptoms of depression and/or anxiety were not alone predictive of a disrupted LCB. We suggested that this was indicative that clinically significant levels of depression and/or anxiety are necessary to disrupt the LCB. We proposed that this relationship may be due to a link between mood disorders and reduced empathy, as displayed

by disruptions in facial-emotional processing and affect regulation. Implications of this finding may lead to early interventions for depressed and/or anxious parents which could benefit the parent-child relationship. Interestingly, this study found that handedness was a large indicator of cradling side, prompting a need for further research in this area. These findings contribute to research into the LCB and provide a further step in understanding the mechanism that underlies it. Despite this, more research is needed into this field if we are to fully understand the universal phenomenon of the LCB.

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Appendix A

SRPP Research Invitation

Hi there, you've been invited to participate in an online research survey!

What do I have to do?

At this stage, you will be asked to complete a 35-minute online survey. You will later be asked to come into the Psychology Department for a 60-minute lab-based session during which you will need to complete two computer tasks while undergoing surface electromyography (EMG) recording. EMG is a completely non-invasive technology that simply involves recording muscle activity from the surface of the skin using electrode stickers.

What about COVID-19?!

The timeline for postgraduate research is largely determined by the dynamic, long-term national response to the COVID-19 pandemic. One of the most important factors to consider is the health and safety of UCT staff members and students. The researcher will only open-up the opportunity for lab-based sessions once the health and safety of both themselves and participants can be ensured. These sessions will hopefully be made available at some point during the second semester. Eligible participants will be contacted via email.

So, what do I get in return?

Although SRPP points are no longer DP requirements, all points earned in 2020 will be carried over to 2021. You will receive 1 SRPP point for completing the survey and an additional 2 points for your full participation in the 60-minute lab-based session. Please note that participation in this study is completely voluntary and you are free to change your mind and discontinue participation at any time without any effect on your relationship with UCT or the department. Note that if you do choose to withdraw from the study, you will not be allocated any SRPP points. After participating in the study, you will receive detailed information regarding its specific aims and hypotheses. There are no known risks involved in this study and its procedures.

Kk, what happens to my data?

Information about you collected for this study will be kept confidential. Your consent form and any other identifying information will not be disclosed to anybody else but the principal

researcher. Any reports about this study will not identify you or any other participant. The equipment and devices used to analyse the data collected from this study will be password protected and physically secured by the researcher.

Eligibility Criteria:

- Over 18 years of
- No biological or adopted children of your own

If you have read the above and would like to participate in the survey, please click on the link below:

https://www.surveymonkey.com/r/GZHPVT5

Please contact Lasse Herdien (hrdlas001@myuct.ac.za) for any questions regarding participation in the study.

Appendix B

Screening Questionnaire

Name: _____

Surname: _____

Student number: _____

Age: _____

Sex: Male ☐ Female ☐ Other ☐

Do you have any history of neurological conditions (e.g., epilepsy, ADHD, TBI-related deficits)?

Yes ☐ No ☐

Other (please specify):

_____

Do you have any history of clinically diagnosed (i.e. by a qualified professional such as a psychiatrist, clinical psychologist or doctor) psychiatric conditions (e.g., depression, anxiety, bipolar disorder, post-traumatic stress disorder)?

Yes ☐ No ☐

Other (please specify):

_____

If you ticked yes to the above question, please specify for how long you have been receiving treatment (i.e. medication or therapy) if at all for the above diagnosis?
e.g. 2015- April 2020

_____

Are you currently taking any chronic or psychiatric medication?

Yes ☐ No ☐

If so, please specify: _____

Do you have any children of your own (including any adopted children)?

Yes □ No □

Specify infant or child age(s):		Children				
		1	2	3	4	5
Newborn	0 – 5 weeks					
Infant	1 month – 1 year					
Toddler	1 – 3 years					
Pre-schooler	3 – 5 years					

Do you have any siblings?

Yes □ No □

Specify sibling age(s):		Siblings				
		1	2	3	4	5
Newborn	0 – 5 weeks					
Infant	1 month – 1 year					
Toddler	1 – 3 years					
Pre-schooler	3 – 5 years					

Have you ever been/are you currently involved in taking care of infants or young children?

Babysitter		Au pair		Day-care Supervisor		Charity		Other	

If other, please specify:

_____

How many children were you responsible for?

Specify infant or child age(s):	Other Children				
	1	2	3	4	5

Newborn	0 – 5 weeks					
Infant	1 month – 1 year					
Toddler	1 – 3 years					
Pre-schooler	3 – 5 years					

Appendix C

Edinburgh Handedness Inventory (EHI)

Please indicate your preferences in the use of hands in the following activities.

	Always Right	Usually Right	Both Equally	Usually Left	Always Left
1. Writing	ð	ð	ð	ð	ð
2. Drawing	ð	ð	ð	ð	ð
3. Throwing	ð	ð	ð	ð	ð
4. Scissors	ð	ð	ð	ð	ð
5. Toothbrush	ð	ð	ð	ð	ð
6. Knife	ð	ð	ð	ð	ð
7. Spoon	ð	ð	ð	ð	ð
8. Hammer	ð	ð	ð	ð	ð
9. Screwdriver	ð	ð	ð	ð	ð
10. A brush or comb	ð	ð	ð	ð	ð
11. Tennis Racket	ð	ð	ð	ð	ð
12. Cricket bat	ð	ð	ð	ð	ð
13. Golf club	ð	ð	ð	ð	ð
14. Broom (upper hand)	ð	ð	ð	ð	ð
15. Rake (upper hand)	ð	ð	ð	ð	ð
16. Striking a match	ð	ð	ð	ð	ð
17. Deal cards	ð	ð	ð	ð	ð
18. Opening a jar	ð	ð	ð	ð	ð
19. Using a key	ð	ð	ð	ð	ð
20. Threading a needle	ð	ð	ð	ð	ð

Appendix D

Autism Spectrum Quotient

Below is a list of statements. Please read each statement very carefully and rate how strongly you agree or disagree with it by circling your answer.

1. I prefer to do things with others rather than on my own.	definitely agree	slightly agree	slightly disagree	definitely disagree
2. I prefer to do things the same way over and over again.	definitely agree	slightly agree	slightly disagree	definitely disagree
3. If I try to imagine something, I find it very easy to create a picture in my mind.	definitely agree	slightly agree	slightly disagree	definitely disagree
4. I frequently get so strongly absorbed in one thing that I lose sight of other things.	definitely agree	slightly agree	slightly disagree	definitely disagree
5. I often notice small sounds when others do not.	definitely agree	slightly agree	slightly disagree	definitely disagree
6. I usually notice car number plates or similar strings of information.	definitely agree	slightly agree	slightly disagree	definitely disagree
7. Other people frequently tell me that what I've said is impolite, even though I think it is polite.	definitely agree	slightly agree	slightly disagree	definitely disagree
8. When I'm reading a story, I can easily imagine what the characters might look like.	definitely agree	slightly agree	slightly disagree	definitely disagree

9. I am fascinated by dates.	definitely agree slightly agree slightly disagree definitely disagree
10. In a social group, I can easily keep track of several different people's conversations.	definitely agree slightly agree slightly disagree definitely disagree
11. I find social situations easy.	definitely agree slightly agree slightly disagree definitely disagree
12. I tend to notice details that others do not.	definitely agree slightly agree slightly disagree definitely disagree
13. I would rather go to a library than a party.	definitely agree slightly agree slightly disagree definitely disagree
14. I find making up stories easy.	definitely agree slightly agree slightly disagree definitely disagree
15. I find myself drawn more strongly to people than to things.	definitely agree slightly agree slightly disagree definitely disagree
16. I tend to have very strong interests which I get upset about if I can't pursue.	definitely agree slightly agree slightly disagree definitely disagree
17. I enjoy social chit-chat.	definitely agree slightly agree slightly disagree definitely disagree
18. When I talk, it isn't always easy for others to get a word in edgeways.	definitely agree slightly agree slightly disagree definitely disagree

19. I am fascinated by numbers.	definitely agree slightly agree slightly disagree definitely disagree
20. When I'm reading a story, I find it difficult to work out the characters' intentions.	definitely agree slightly agree slightly disagree definitely disagree
21. I don't particularly enjoy reading fiction.	definitely agree slightly agree slightly disagree definitely disagree
22. I find it hard to make new friends.	definitely agree slightly agree slightly disagree definitely disagree
23. I notice patterns in things all the time.	definitely agree slightly agree slightly disagree definitely disagree
24. I would rather go to the theatre than a museum.	definitely agree slightly agree slightly disagree definitely disagree
25. It does not upset me if my daily routine is disturbed.	definitely agree slightly agree slightly disagree definitely disagree
26. I frequently find that I don't know how to keep a conversation going.	definitely agree slightly agree slightly disagree definitely disagree
27. I find it easy to "read between the lines" when someone is talking to me.	definitely agree slightly agree slightly disagree definitely disagree
28. I usually concentrate more on the whole picture, rather than the small details.	definitely agree slightly agree slightly disagree definitely disagree

29. I am not very good at remembering phone numbers.	definitely agree slightly agree slightly disagree definitely disagree
30. I don't usually notice small changes in a situation, or a person's appearance.	definitely agree slightly agree slightly disagree definitely disagree
31. I know how to tell if someone listening to me is getting bored.	definitely agree slightly agree slightly disagree definitely disagree
32. I find it easy to do more than one thing at once.	definitely agree slightly agree slightly disagree definitely disagree
33. When I talk on the phone, I'm not sure when it's my turn to speak.	definitely agree slightly agree slightly disagree definitely disagree
34. I enjoy doing things spontaneously.	definitely agree slightly agree slightly disagree definitely disagree
35. I am often the last to understand the point of a joke.	definitely agree slightly agree slightly disagree definitely disagree
36. I find it easy to work out what someone is thinking or feeling just by looking at their face.	definitely agree slightly agree slightly disagree definitely disagree
37. If there is an interruption, I can switch back to what I was doing very quickly.	definitely agree slightly agree slightly disagree definitely disagree

38. I am good at social chit-chat.	definitely agree	slightly agree	slightly disagree	definitely disagree
39. People often tell me that I keep going on and on about the same thing.	definitely agree	slightly agree	slightly disagree	definitely disagree
40. When I was young, I used to enjoy playing games involving pretending with other children.	definitely agree	slightly agree	slightly disagree	definitely disagree
41. I like to collect information about categories of things (e.g. types of car, types of bird, types of train, types of plant, etc.).	definitely agree	slightly agree	slightly disagree	definitely disagree
42. I find it difficult to imagine what it would be like to be someone else.	definitely agree	slightly agree	slightly disagree	definitely disagree
43. I like to plan any activities I participate in carefully.	definitely agree	slightly agree	slightly disagree	definitely disagree
44. I enjoy social occasions.	definitely agree	slightly agree	slightly disagree	definitely disagree
45. I find it difficult to work out people's intentions.	definitely agree	slightly agree	slightly disagree	definitely disagree
46. New situations make me anxious.	definitely agree	slightly agree	slightly disagree	definitely disagree
47. I enjoy meeting new people.	definitely agree	slightly agree	slightly disagree	definitely disagree

48. I am a good diplomat.	definitely agree slightly agree slightly disagree definitely disagree
49. I am not very good at remembering people's date of birth.	definitely agree slightly agree slightly disagree definitely disagree
50. I find it very easy to play games with children that involve pretending.	definitely agree slightly agree slightly disagree definitely disagree

Appendix E

Demonstration of the Cradling Position

Imagine that you are holding a small infant in your arms. Try to imagine the infant's face, eyes, mouth, body, and arms. Now position your arms as if you were gently soothing the infant or putting it to sleep. Turn your head to look at the infant's face. To which side are you looking? To your left or right side?

Appendix F

Questionnaire of Cognitive and Affective Empathy (QCAE)

Below is a list of statements. Please read each statement very carefully and rate how strongly you agree or disagree with it by circling your answer.

1. I can easily work out what another person might want to talk about.	definitely agree	slightly agree	slightly disagree	definitely disagree
2. I can tell if someone is masking their true emotion.	definitely agree	slightly agree	slightly disagree	definitely disagree
3. I can sense if I am intruding, even if the other person does not tell me.	definitely agree	slightly agree	slightly disagree	definitely disagree
4. I am good at predicting how someone will feel.	definitely agree	slightly agree	slightly disagree	definitely disagree
5. I am good at predicting what someone will do.	definitely agree	slightly agree	slightly disagree	definitely disagree
6. I am quick to spot when someone in a group is feeling awkward or uncomfortable.	definitely agree	slightly agree	slightly disagree	definitely disagree
7. I can pick up quickly if someone says one thing but means another.	definitely agree	slightly agree	slightly disagree	definitely disagree
8. I can easily tell if someone else is interested or bored with what I am saying.	definitely agree	slightly agree	slightly disagree	definitely disagree
9. I can easily tell if someone else wants to enter a conversation.	definitely agree	slightly agree	slightly disagree	definitely disagree
10. Other people tell me I am good at understanding how they are feeling and what they are thinking.	definitely agree	slightly agree	slightly disagree	definitely disagree
11. I am happy when I am with a cheerful group and sad when the others are glum.	definitely agree	slightly agree	slightly disagree	definitely disagree
12. It worries me when others are worrying and panicky.	definitely agree	slightly agree	slightly disagree	definitely disagree
13. People I am with have a strong influence on my mood	definitely agree	slightly agree	slightly disagree	definitely disagree
14. I am inclined to get nervous when others around me seem to be nervous.	definitely agree	slightly agree	slightly disagree	definitely disagree
15. I try to look at everybody's side of a disagreement before I make a decision	definitely agree	slightly agree	slightly disagree	definitely disagree
16. Before criticizing somebody, I try to imagine how I would feel if I was in their place.	definitely agree	slightly agree	slightly disagree	definitely disagree

17. When I am upset at someone, I usually try to "put myself in his shoes" for a while.	definitely agree	slightly agree	slightly disagree	definitely disagree
18. I always try to consider the other fellow's feelings before I do something	definitely agree	slightly agree	slightly disagree	definitely disagree
19. I sometimes try to understand my friends better by imagining how things look from their perspective.	definitely agree	slightly agree	slightly disagree	definitely disagree
20. I can usually appreciate the other person's viewpoint, even if I do not agree with it.	definitely agree	slightly agree	slightly disagree	definitely disagree
21. I sometimes find it difficult to see things from the "other guy's" point of view.	definitely agree	slightly agree	slightly disagree	definitely disagree
22. Before I do something, I try to consider how my friends will react to it.	definitely agree	slightly agree	slightly disagree	definitely disagree
23. I find it easy to put myself in somebody else's shoes.	definitely agree	slightly agree	slightly disagree	definitely disagree
24. I usually stay emotionally detached when watching a film.	definitely agree	slightly agree	slightly disagree	definitely disagree
25. I am usually objective when I watch a film or play, and I don't often get completely caught up in it.	definitely agree	slightly agree	slightly disagree	definitely disagree
26. I often get deeply involved with the feelings of a character in a film, play, or novel.	definitely agree	slightly agree	slightly disagree	definitely disagree
27. It is hard for me to see why some things upset people so much.	definitely agree	slightly agree	slightly disagree	definitely disagree
28. I often get emotionally involved with my friends' problems.	definitely agree	slightly agree	slightly disagree	definitely disagree
29. Friends talk to me about their problems as they say that I am very understanding.	definitely agree	slightly agree	slightly disagree	definitely disagree
30. It affects me very much when one of my friends seems upset.	definitely agree	slightly agree	slightly disagree	definitely disagree
31. I get very upset when I see someone cry.	definitely agree	slightly agree	slightly disagree	definitely disagree

Appendix G

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 H

State-Trait Anxiety Inventory

A number of statements which people have used to describe themselves are given below. Read each statement and then select the appropriate response option to indicate how you *feel* right now, *at this moment*. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

	Not At All	Somewhat	Moderately So	Very Much So
I feel calm.				
I feel secure.				
I am tense.				
I feel strained.				
I feel at ease.				
I feel upset.				
I am presently worrying about possible misfortunes.				
I feel satisfied.				
I feel frightened.				
I feel comfortable.				
I feel self-confident.				
I feel nervous.				
I am jittery.				
I feel indecisive.				
I am relaxed.				
I feel content.				
I am worried.				
I feel confused.				
I feel steady.				
I feel pleasant.				

A number of statements which people have used to describe themselves are given below. Read each statement and then select the appropriate response option to indicate how you

generally feel. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel.

	Almost Never	Sometimes	Often	Almost Always
I feel pleasant.				
I feel nervous and restless.				
I feel satisfied with myself.				
I wish I could be as happy as others seem to be.				
I feel like a failure.				
I feel rested.				
I am “calm, cool, and collected”.				
I feel that difficulties are piling up so that I cannot overcome them.				
I worry too much over something that really doesn’t matter.				
I am happy.				
I have disturbing thoughts.				
I lack self-confidence.				
I feel secure.				
I make decisions easily.				
I feel inadequate.				
I am content.				
Some unimportant thought runs through my mind and bothers me.				
I take disappointments so keenly that I can’t put them out of my mind.				
I am a steady person.				
I get in a state of tension or turmoil as I think over my recent concerns and interests.				

Appendix I

SRPP Informed Consent

Dear participant,

Thank your choosing to take part in this research study investigating sex differences in facial recognition.

Procedure

At this stage, you will be asked to complete a 35-minute online survey. You will later be asked to come into the Psychology Department for a 60-minute lab-based session during which you will need to complete two computer tasks while undergoing surface electromyography (EMG) recording. EMG is a completely non-invasive technology that simply involves recording muscle activity from the surface of the skin using electrode stickers.

Concerns Regarding COVID-19 Pandemic

The timeline for postgraduate research is largely determined by the dynamic, long-term national response to the COVID-19 pandemic. One of the most important factors to consider is the health and safety of UCT staff members and students. The researcher will only open-up the opportunity for lab-based sessions once the health and safety of both themselves and participants can be ensured. These sessions will hopefully be made available at some point during the second semester. Eligible participants will be contacted via email.

Possible risks and benefits

Although SRPP points are no longer DP requirements, all points earned in 2020 will be carried over to 2021. You will receive 1 SRPP point for completing the survey and an additional 2 points for your full participation in the 60-minute lab-based session. Please note that participation in this study is completely voluntary and you are free to change your mind and discontinue participation at any time without any effect on your relationship with UCT or the department. Note that if you do choose to withdraw from the study, you will not be allocated any SRPP points. After participating in the study, you will receive detailed information regarding its specific aims and hypotheses. There are no known risks involved in this study and its procedures.

Confidentiality

Information about you collected for this study will be kept confidential. Your consent form and any other identifying information will not be disclosed to anybody else but the principal

researcher. Any reports about this study will not identify you or any other participant. The equipment and devices used to analyze the data collected from this study will be password protected and physically secured by the researcher.

This study has been approved by the Department of Psychology at the University of Cape Town. Any study-related questions or issues should be directed to any of the following individuals:

Principal Researcher
Lasse Herdien
Department of Psychology
University of Cape Town
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Postgraduate Administrative Assistant
Rosalind Adams
Department of Psychology
University of Cape Town
rosalind.adams@uct.ac.za
(021) 650 4104

Please note the following eligibility criteria:

- Over 18 years of age
- No biological or adopted children of your own

If you are willing to comply with the study and its procedure, please complete the consent form.

I have read the consent form and am satisfied with my understanding of the study and its possible risks and benefits. I hereby voluntarily consent to participation in the research study as described.

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Signature of participant **Date (DD/MM/YYYY)**

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Name of participant (printed) **Student Number**

Course Code

Appendix J

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

Dr L. Pileggi
Department of Psychology
University of Cape Town
Rondebosch 7701

Dear Dr Pileggi

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, *Investigating the Prevalence and Correlates of Leftward Cradling Bias across Age and Gender.* The reference number is PSY2019-013.

I wish you all the best for your study.

Yours sincerely

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

Appendix K

Debriefing Form

Dear participant,

Thank you again for taking part in this study. This document serves to provide you with information on the nature and purpose of the research.

Overview

The aim of the current study was not to investigate sex differences in facial recognition, but rather to examine the phenomenon of leftward cradling bias. Leftward cradling bias refers to the well-established human tendency to cradle an infant on the left side of the body while soothing or putting it to sleep. Various explanations have been put forward to account for this bias, the most compelling of which is the hemispheric lateralisation theory for emotional processing. In line with this notion, recent research suggests a specific relationship between the leftward cradling bias and one's capacity for empathy, although this link is yet to be replicated adequately and few studies to date have included direct and adequate measures of empathy. The aim of the current study was to investigate the relationship between different forms of empathy and cradling bias. The study therefore included direct and indirect measures of both cognitive (higher-order) and affective (lower-order) empathy.

Measures

Below you will find a brief description of each of the measures used in the study:

Handedness Questionnaire: This simple 20-item assessment tool is used to determine an individual's hand dominance (i.e., right-handed, left-handed, or ambidextrous). Many individuals tend to rationalise the leftward cradling bias in terms of hand preference (i.e., right-handers suggest that they hold their baby on the left side so that their dominant hand is free to perform other tasks). However, many studies show that a significant majority of left-handers also cradle to the left side. Nonetheless, there is some evidence that the percentage who do so is lower than that observed in right-handers. Thus, the questionnaire was employed in the present study to determine whether handedness has any degree of influence on cradling preference.

Autism Spectrum Quotient (AQ): The AQ is used to assess where individuals with normal intelligence lie on the autism spectrum and to therefore identify the degree to which an individual may have "autistic traits". The questionnaire consists of 50 questions which refer to 5 different areas of a person's daily life: imagination, attention switching, attention to detail,

communication, and social skills. It is important to note that the AQ is not a diagnostic tool and that a high AQ score does not merit a diagnosis.

Cradling Bias Task: The present study utilised an imaginary cradling task consisting of four trials administered independently between each of the other measures so as to establish a reliable measure of cradling bias. It is important to note that a rightward cradling bias is not indicative of any specific deficit or abnormality.

The Questionnaire of Cognitive and Affective Empathy (QCAE): The QCAE is one of the few empathy scales that explicitly assess both cognitive and affective aspects of empathy. The QCAE consists of five subscales (31 items total) of which the first two measure cognitive empathy and the remaining three measure affective empathy. Items are rated on a 4-point scale ranging from 'Strongly Agree' to 'Strongly Disagree'.

Beck Depression Inventory. The Beck Depression Inventory is a well-known questionnaire measuring symptoms of Depression. It consists of 21 questions pertaining to symptoms often associated with Depression. It is important to note that a high score on this questionnaire does not merit a diagnosis.

State-Trait Anxiety Inventory. This questionnaire is a well-known measure of symptoms of Anxiety. In this questionnaire you completed two versions of the questionnaire; The first 'state' version asked you to indicate how you are feeling at the moment (i.e., while you were completing the questionnaire) and the second 'trait' version asked you to indicate how you generally feel (i.e., you general mood state).

Deception

The true aims of the study were concealed in order to prevent you and other participants from developing any specific ideas around the research that could influence your performance on any of the study's assessment tools, particularly the cradling bias task.

Please do note that while many individuals prefer to cradle to the left, roughly a quarter of the population still cradle to the right. Rightward cradling is not to be interpreted as negative; it is also normal to cradle to the right.

If you have experienced any distress or anger as a result of participating in the study or from learning of the deception used therein, please direct these issues to one of the following individuals:

Principal Researcher
Lasse Herdien

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Alternatively, please feel free to contact **UCT Student Wellness Services**:
Phone: 021 650 1017; **Address**: Ivan Toms Building, 28 Rhodes Avenue, Mowbray

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: 021 461 1111
South African Depression and Anxiety Group: 0800 12 13 14