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Title:
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Date:
2018-11-01

Citation:
Rossen, L., Mattick, R. P., Wilson, J., Burns, L., Macdonald, J. A., Olsson, C., Allsop, S., Elliott, E. J., Jacobs, S., McCormack, C. & Hutchinson, D. (2018). Mother–Infant and Partner–Infant Emotional Availability at 12 Months of Age: Findings From an Australian Longitudinal Study. Infancy, 23 (6), pp.893-916. https://doi.org/10.1111/infa.12247.

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Article type : Research Article

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Title

Mother- and partner-infant emotional availability at 12-months of age: Findings from an Australian Longitudinal Study

Abstract

Emotional Availability (EA) is a focal indicator of parent-infant relationship quality and plays a key role in determining healthy child development, yet factors thought to influence EA have not been examined comprehensively in the postnatal period in both mothers *and partners*. The aim of this study was to examine the influence of mother- and partner-infant bonding, mental ill-health and substance use at 8-weeks post-birth on mother- and partner-infant EA at 12-months post-birth, accounting for a range of demographic and postnatal variables. Participants were 191 matched mother-partner-infant triads from a nested sample of an Australian longitudinal pregnancy cohort (The Triple B Pregnancy Cohort). Assessments were conducted at 8-weeks post-birth and at infant age 12-months. Parental EA was coded from dyadic interactions during a 20-minute free-play observational video recorded at 12-months. Generalised Estimating Equations (GEE) analysis, accounting for within dyad clustering, showed older parent age was associated with higher parent-child EA

scores (χ^2=6.28, p<.01), while parental tobacco use (χ^2=7.35, p<.01) and depression (χ^2=4.51, p<.05) at 8-weeks postnatal predicted poorer parent-child EA scores at 12-months. These novel findings suggest that it may be particularly important to support young couples and those struggling with symptoms of depression or tobacco use during the postnatal period.

Introduction

The quality of an infant's relationship with his/her primary caregiver sets a critical context for healthy development (Bornstein, 2002; Bornstein, Hendricks, Haynes, & Painter, 2007; Espinet et al., 2013; Skovgaard et al., 2007). Children's ability to regulate attention, arousal and emotion develops in the context of their primary caregiving relationships during infancy (Bornstein, Suwalsky, & Breakstone, 2012) and is fundamental to the development of organising behaviour, social relationships and adaptive functioning (Sroufe, 2005). Past literature has almost exclusively focused on the *mother*-infant relationship, however it is increasingly recognised that *partners* (typically fathers) play a central role in influencing child development (Lucassen et al., 2011; Paulson & Bazemore, 2010; Sarkadi, Kristiansson, Oberklaid, & Bremberg, 2008) and the family context more generally (Dette-Hagenmeyer, Erzinger, & Reichle, 2017).

Emotional Availability

Emotional Availability (EA) is the capacity of parent-infant dyads to share an affective connection and enjoy a mutually fulfilling and healthy relationship (Biringen & Easterbrooks, 2012). EA reflects a parent's adeptness at concurrently managing their own emotional regulation whilst simultaneously guiding the infant's developing regulatory capacity. Parents exhibiting higher emotional availability have a 'receptive presence' to the child's emotional signals, while the child's emotional signalling in turn elicits behaviours that underpin a secure parent-infant attachment relationship (Biringen & Easterbrooks, 2012). Despite EA being thought to reflect important processes in determining mother-infant relationship quality, a range of factors associated with EA have not been examined comprehensively in the postnatal period (8-weeks to 12-months) in both mothers *and partners*. In particular, factors that indicate emotional dysregulation in domains such as mental health and substance use will plausibly challenge EA. Emotion dysregulation is increasingly understood as a transdiagnostic construct, central to multiple psychopathologies, and may represent a core indicator of intergenerational emotional problems (Sloan et al., 2017).

Depression

In individuals with depressive symptoms, emotion dysregulation can manifest as distorted thinking and impaired judgement, which in turn can impact parental sensitivity and responsiveness to the infant, both of which are key components of EA (Lefkovics, Baji, & Rigó, 2014). Depressive symptoms such as anhedonia and low or dysregulated affect are in contradiction with the concept of emotional availability as they are indicators of a reduced capacity or motivation to attune to external stimuli, including the needs of an infant (Bansil et al., 2010; Flores-Ramos et al., 2013). Depressive symptoms may therefore undermine emotional availability and impact on the infant's social, psychological, behavioural and cognitive development (Misri & Kendrick, 2008).

In past research, parent depressive symptoms have been associated with reduced sensitivity to children (van Doesum, Hosman, Riksen-Walraven, & Hoefnagels, 2007). Longitudinal research of mother-child dyads (n=92) has shown associations between chronic maternal depression and lower levels of maternal sensitivity, mediated by mothers' impaired capacity to take their child's perspective (Trapolini, Ungerer, & McMahon, 2008). Furthermore, lower EA scores and engagement difficulties in infant play interactions have been found in women with depressive symptoms (n=45) and among mothers who were depressed postnatally (n=49), compared with nondepressed mothers (n=35) (Easterbrooks, Biesecker, & Lyons-Ruth, 2000; Vliegen et al., 2005; Vliegen, Luyten, & Biringen, 2009).

While evidence points to an association between postnatal depression and poorer mother-infant interactions, empirical results have been inconsistent. In some studies, few differences exist between depressed and non-depressed mothers in the quality of interactions, with the exception of increased likelihood of intrusiveness in interactions with their infants than non-depressed mothers (Cornish, McMahon, & Ungerer, 2008). Another study found that while mothers' depressive symptoms were not related to EA (Kim, Teti, & Cole, 2012), other indicators of emotion dysregulation such as mothers' tendency to externalise (e.g., eating to feel better, getting into a fight to release anger, and throwing or hitting things when arguing) predicted lower EA (Kim et al., 2012). Null findings also exist whereby no differences in EA were identified between depressed and nondepressed mothers (Biringen, Derscheid, Vliegen, Closson, & Easterbrooks, 2014). As such, the relationship between postnatal depression in mothers and later EA is unclear. More uncertain, due to the scarcity of research available, is the relationship between paternal depression and emotional availability in parent-child

relations, and the effects of both maternal and paternal depression on parent-child interactions, specifically assessed with the EA Scales.

Stress and anxiety

Stress and anxiety are also indicators of emotion regulation problems that may affect parent-child EA. Feelings of stress and anxiety are markers of hypervigilance to threat and so may theoretically prompt parents to focus attention away from the child, or if the anxiety is related to the child, to distort appraisals regarding the infant's need for protection (Davies, 2010; Thompson, 2001). Prior research into EA has found that maternal anxiety was associated with EA sub facets including reduced sensitivity, less structure and less child involvement in interactions with toddlers at 24-months, but these findings were limited to dyads in a neonatal intensive care unit (NICU) (Zelkowitz, Papageorgiou, Bardin, & Wang, 2009). Higher levels of maternal posttraumatic stress symptoms have also been shown to be associated with greater insensitivity, unstructuring, or hostility, but not intrusive parent-child interactions at 18-24 months (van Ee, Kleber, & Mooren, 2012). A gap remains in assessment of anxiety and stress associations with EA in longitudinal community samples that assess both mothers *and partners*.

Substance use: alcohol and tobacco

Substance use (e.g., alcohol, tobacco or illicit substance use) is also a marker of affective dysregulation and may suppress the intensity of a parent's feeling toward an infant, reducing capacity to build healthy emotional connections. Most research in the area of parent-infant relationships has focused on 'substance abuse', defined as the harmful or hazardous use of psychoactive substances including alcohol and illicit drugs (World Health Organization, 2004). For example, there is evidence that heavy maternal alcohol use prenatally is associated with negative infant affect, which negatively influences the mother-infant relationship at 12-months post-birth (O'Connor, Sigman, & Kasari, 1992). Yet, in this study, maternal alcohol consumption following pregnancy did not influence maternal interactions. Prenatal alcohol exposure has also been significantly related to bonding insecurity and negative child affect, but this was in children at four to five years of age (O'Connor, Kogan, & Findlay, 2002; O'Connor & Paley, 2006). In relation to EA, lower mother-infant EA has been found in circumstances where the mother is substance dependent (Espinet et al., 2013; Flykt et al., 2012; Fraser, Harris-Britt, Thakkallapalli, Kurtz-Costes, & Martin, 2010; Salo et al., 2009; Salo et al., 2010; Swanson, Beckwith, & Howard, 2000a); however, it is unclear whether

more common patterns of alcohol use (e.g., low to moderate drinking) are associated with bonding and EA. Notably, there is scant, if any, literature examining tobacco use in the early postnatal period (8-weeks) and relevant associations with parent-infant relations at 12-months of age, especially those including *partners*.

Key gaps in the literature on EA

With regard to understanding how markers of emotional dysregulation are associated with the developing emotional connection between parents and infants, there are three key gaps in the literature relevant to this study. First, past research using the EA construct has largely been assessed in preschool aged children, typically with cross-sectional designs (Biringen & Easterbrooks, 2012). There exists a paucity of studies on EA that have utilised longitudinal designs, see Biringen et al., (2014) for a review of existing EA literature; yet, this approach enables a clearer understanding of risk and protective mechanisms for outcomes in relation to EA. Second, most studies have focused on particular aspects of the EA scales (i.e., the EA dimensions), predominantly maternal sensitivity (Biringen et al., 2014) or the non-intrusiveness dimension of the EA Scales (Swanson, Beckwith, & Howard, 2000b). Examination and prediction of the EA *total* scores takes into account both the mother and infant's contribution to the relationship[1], reflecting the *dyadic* interaction between the infant and his or her caregiver. Finally, past literature has almost exclusively focused on the *mother*-infant relationship. Measuring EA in *partners* (typically fathers) is critically important, as fathers are becoming increasingly involved in parenting which might affect the relationship with their infant (Lucassen et al., 2011; Pleck, 2010). Understanding EA in the context of the couple relationship and the family system would add significantly to our understanding of the roles that both parents play in the infant-caregiving system.

Subjective appraisals of the parent-infant bond

A further gap is a lack of studies that include examination of both observed parent-infant interactions and the parent's self-reported emotional bond to their infant. Typically the quality of the parent-infant bond has been assessed using either self-report measures, e.g., the Postpartum Bonding Questionnaire (Brockington et al., 2001), or via observational assessments, e.g., the Strange Situation Protocol (Ainsworth, Blehar, Waters, & Wall, 1978).

[1] The EA total score is a summation of all maternal and child EA dimensions. Please see the Method section for scoring details of the EA Scales.

Using a multi-method approach to assessing this relationship may provide a more accurate assessment than one method alone (Vliegen et al., 2009). Variations in mode of assessment (i.e., self-report versus observational) may also influence the way in which the parent-child relationship is coded and understood. Therefore, we sought to understand how self-report and observational methods would each provide unique information about parent-infant relationship quality at 12 months post-birth.

Research has shown associations between bonding measured at different time-points in the perinatal period: prenatal bonding has been associated with postnatal bonding (Rossen et al., 2016; Rossen et al., 2017) while bonding was shown to be associated at four weeks, four months and eight months postnatal (Condon & Corkindale, 1998). Whilst EA has been studied extensively in relation to attachment (Altenhofen, Clyman, Little, Baker, & Biringen, 2013; Altenhofen, Sutherland, & Biringen, 2010), including Strange Situation protocol (Aviezer, Sagi-Schwartz, & Koren-Karie, 2003; Aviezer, Sagi, Joels, & Ziv, 1999; Biringen et al., 2005; Carter, Garrity-Rokous, Chazan-Cohen, Little, & Briggs-Gowan, 2001; Easterbrooks et al., 2000; Ziv, Aviezer, Gini, Sagi, & Karie, 2000), the relationship of early self-reported bonding (8-weeks postnatal) and EA at 12-months, has yet to be examined. In particular, these assocations have not previously been investigated in a large community sample that included both mothers and partners, using a longitudinal cohort study design.

Research questions

The present study sought to address a number of gaps in the EA literature, identified above, by examining a range of factors that indicate emotional dysregulation and are plausibly associated with EA in infancy. Using a sample of mother- and partner-dyads in a population study of Australian parents, the specific aims of the study were to examine the extent to which mother and partner postnatal bonding, mental health and substance use at infant age 8-weeks predicted mother- and partner-infant EA at 12-months of age, controlling for demographic and postnatal factors. It was hypothesised that early bonding would be associated with higher EA scores at 12-months, while mental ill-health and substance use would be associated with lower EA scores at 12-months. Furthermore, this study employed a dyad analysis to account for the interdependence between mothers and their partners, which has not been used extensively in parent-child research (Gonzalez & Griffin, 1997, 1999; Griffin & Gonzalez, 1995). Failure to account for these interpersonal correlations can introduce bias into an analysis (Gonzalez & Griffin, 1999). Therefore, a second aim of the study was to examine the extent to which parental bonding, mental health and substance use

at infant age 8-weeks predicted parent-infant EA at 12-months of age, accounting for the correlated dyadic influence, in addition to other demographic and postnatal variables. It was similarly hypothesised that early bonding would be associated with higher EA scores at 12-months, while mental ill-health and substance use would be associated with lower EA scores at 12-months.

Method

Data were obtained from a nested sub-study of the Triple B Pregnancy Cohort Study (Hutchinson et al., 2017). Triple B is a longitudinal study conducted by the National Drug and Alcohol Research Centre (NDARC) at the University of New South Wales (UNSW) in Sydney, and by the National Drug Research Institute (NDRI) at Curtin University, Perth, in collaboration with Deakin University, and the Universities of Sydney and Queensland. The broader study examines the impact of parental substance use on infant development and family functioning from the time of conception, taking into account the influence of a range of additional factors, including sociodemographic variables, diet and nutrition, psychological and physical health, and social support. A total of 1,623 women were recruited during pregnancy between 2009 and 2013, as were their offspring and partners. The current study involves a subsample of participants from NSW for whom observational EA data were available for matched pairs of parents and children.

Ethics approval was obtained from the Human Research Ethics Committees of each participating hospital, the Area Health Services in which the hospitals were located and UNSW. The present study was conducted in accordance with guidelines laid down in the Declaration of Helsinki, with written informed consent obtained from a parent or guardian for each child before any assessment or data collection. All procedures involving human subjects in this study were also approved by the Human Research Ethics Committees of each participating hospital (incuding Area Health Services) and UNSW.

Procedure

Pregnant women were approached by trained researchers in waiting rooms at general antenatal clinics and specialist drug and alcohol antenatal clinics attached to major public hospitals and Area Health Services in NSW. Women, partners and infants were followed up prospectively, maternal data being collected by structured interviews and self-complete questionnaires during each trimester, and at 8-weeks and 12-months postpartum.

Participants

Participants comprised a subsample of 191 mother and partner dyads recruited between October 2008 and August 2012, who had completed all requisite measures at the time of analysis. Families were approached during their pregnancy through Royal Prince Alfred Hospital (RPA), the Royal Hospital for Women (RHW) and Liverpool Hospital. Eligibility criteria were: mothers being pregnant (at any stage from conception to 40 weeks gestation); being aged 16 years or more; having no major medical complications (mother or fetus); residing in NSW; mother or both parents intending to be the primary caregiver/s; being mentally able to complete study measures; and possessing sufficient literacy in English to do so. Comparisons between the sample and mothers who gave birth during the same time period, but who had not completed all required measures at the time of analysis (i.e., recruited but not yet interviewed on all available measures relevant to this study) showed similar sociodemographic characteristics (age, country of birth and SEIFA), with the exception that women included in the sample were more likely to be employed either full time or part-time (N=1574; χ^2 (2) = 15.47; p<.01) and more likely to be university educated (N=1582 χ^2 (2) = 15.21; p<.01). Partners included in the current sample were more likely to be employed either full time or part-time (N=824; χ^2 (2) = 7.16; p<.05).

Comparing the sample to the Australian population of women giving birth in 2012 (Hilder, Zhichao, Parker, Jahan, & Chambers, 2014): the average maternal age in the study (32.4 years) was similar to that the general population (30-years). It was the first pregnancy for 44.5% of women in this study, and 42.4% of women in the population. The average gestational age in the study was 39.4 weeks, similar to the population average of 38.8-weeks; and the average weight of babies in this study, at 3.45kgs, was similar to the population average of 3.37kgs. Factors that appeared different to the population (Hilder et al., 2014) include: 1% of women in this study were from an Indigenous background, compared to 4% of women in the general population; 55.5% of women in this study were born in Australia, while 68.8% of women giving birth in the population are Australian-born. In this study, 5.2% of women smoked tobacco, which was half the rate of women smoking during pregnancy in the population.

Demographic information and birth outcomes

Demographic variables, recorded for both mothers and partners during pregnancy, included: age; marital status; employment status; SEIFA; highest level of education; country of birth; Aboriginal or Torres Strait Islander status; living arrangements (renting, privately own, staying with friends/family); desire to be pregnant (yes/no) and whether or not it was the mother's first pregnancy (yes/no). Data about the birth were collected via interview and from child health records at 8-weeks postpartum. This included birth weight (kilograms) and gestation in weeks.

The Australian Bureau of Statistics (ABS) Socio-Economic Indexes for Areas (SEIFA) was used as a measure of relative advantage and disadvantage for place of residence, providing a standardised measure to compare the SES of the present sample with the general Australian population (Australian Bureau of Statistics, 2008). Deciles are distributed between ten equal groups, with the first decile representing the lowest scoring 10% of geographical areas, and the tenth decile representing the highest scoring 10% (Pink, 2008). These deciles were collapsed into the following categories for our analyses: low SES (deciles 1-3); medium SES (deciles 4-7); and high SES (deciles 8-10). Using the SEIFA Index of Relative Socio-economic Advantage and Disadvantage (IRSAD) score, the mean IRSAD score in the present sample was 1052.4 (SD=56.6), slightly higher than the population mean of 1,000 (Pink, 2008).

Bonding to the infant

The Maternal Postnatal Attachment Scale (MPAS; 19-items) (Condon & Corkindale, 1998) was used to measure a mother's reported feelings about her infant at 8-weeks and 12-months of age. The measure consists of three factors*:* (1) *quality of bonding* (9-items; range 9-38): confidence and satisfaction in the interaction with the infant; (2) *absence of hostility* (5-items; range 5-22): the absence of hostile or angry feelings towards one's infant; and, (3) *pleasure in interaction* (5-items; range 5-19)*:* the desire for physical closeness and happiness in interaction with one's infant (McMahon, 1997). To ensure equal weighting of all questions, all response options were recoded to represent a score of one (low bonding) to five (high bonding). The sum of the 19-items forms the total MPAS score, with higher scores indicating more adaptive mother-infant bonding. The scale has demonstrated reliability and construct validity (Condon & Corkindale, 1998). The Cronbach alpha value for the total scale in this sample was 0.65 at 8-weeks.

The Paternal Postnatal Attachment Scale (PPAS; 19 items) (Condon, Corkindale, & Boyce, 2008) was used to measure partner's reported feelings towards their infants at 8-weeks and 12-months of age. This scale also has three factors: (1) *patience and tolerance* (8 items; range 8-33), the absence of irritability and negative feelings toward the infant; (2) *pleasure in interaction* (7 items; range 6-25), feelings of pleasure, satisfaction and competence in interaction; and, (3) *affection and pride* (4 items: range 4-17), a sense of affection and 'ownership'. Sample items include: "When I am not with the baby I find myself thinking about the baby" and "I can understand what my baby needs or wants". Possible scores on the PPAS scale range from 19 (poor bonding) to 95 (strong bonding). In the current sample Cronbach alpha coefficient for internal consistency was 0.78 at 8-weeks for the total scale.

Emotional availability

The Emotional Availability (EA) Scales, 4th edition (Biringen, 2008) were used to code the quality of dyadic interactions during a 20-minute free play observational session video recorded at 12-months of age. Videos were taken with mothers and their infants, and separately with partners and their infants. The EA Scales consist of six globally rated dimensions concerned with emotional communication and interaction in the parent-infant dyad; four dimensions relating to the adult (sensitivity, structuring, non-intrusiveness, and non-hostility) and two to the child (responsiveness and involvement). Scores range from 1 to 7 for the first two items within a dimension and 1 to 3 for the remaining five items (total range: 7-29), yielding a final 7-point score for each dimension, as per instructions in the 4th Edition EA Scales Manual (Biringen, 2008). (Biringen, 2008; Biringen et al., 2014). The four adult dimensions include: (1) *Adult sensitivity*, which focuses on appropriate and positive affective exchanges, and clear, accurate assessment of child behavioural and emotional cues; (2) *Adult structuring*, which assesses the extent to which the adult appropriately follows the child's lead, but also guides the child's play and sets limits as needed; (3) *Adult non-intrusiveness*, which assesses the extent to which the parent is involved in the child's play without over-directing, over-stimulating, or undermining the child's autonomy; and, (4) *Adult hostility*, which evaluates the presence of overt (threatening, frightening, demeaning, or critical behaviour or remarks) and covert hostility (expressions of boredom, impatience). The two child dimensions include: (1) *Child responsiveness to the adult*, which focuses on the child's emotional and social responsiveness to the caregiver reflected in two aspects of the child's behaviour – affect and responsiveness; and, (2) *Child involvement of the adult*, which

refers to the child's ability to involve the parent in his/her play and the activity in general, thus including the adult in the interaction.

The newest (4th) edition of the EA Scales Manual includes the Emotional Attachment & Emotional Availability (EA2) Clinical Screener, which provides not only the means to summarise the EA Scales, but also a means to provide an ''attachment'' score (Biringen, 2008; Biringen et al., 2014). The screener scores range between 1 and 100, and an adult–infant relationship is assigned into one of four zones – ''problematic zone'' (1–40), ''detachment'' (41–60), ''complicated emotional availability'' (61–80), and ''dyadic emotionally availability'' (81–100), with the lowest three zones all considered ''risky'', albeit at different levels. Hence, the EA2 Clinical Screener was used alongside the EA Scales Manual to score interactions between 1 and 100 in this study. Analyses were run with the Global Total EA score (range:1-100) derived from the EA Clinical Screener. High scores represent more optimal EA.

The reliability and stability of the EA Scales across contexts and over time is well documented (Bornstein et al., 2008). Construct validity has been established through links with maternal representations of the self as parent (Biringen, 2000), and with infant–mother attachment (Ziv et al., 2000). Research staff coding the play sessions were trained in using the EA Scales. Coders scored the interactions from video-tapes of live play-sessions. The Global Total EA composite score was derived from the EA2 Clinical Screener (range: 1-100) alongside the four adult and two child dimensions in the 4th Edition Manual (Biringen, 2008).

Inter-rater reliability (Intra-Class Coefficient; ICC) between coders for the overall Global Total EA score on a random sample of 23 mothers (r = .82) and 23 partners was high (r = .85). Good to very good inter-rater reliability on individual dimensions of the EA Scales were found using Cohen's Weighted Kappa, with maternal details as follows: Maternal Sensitivity (κ=.63, p<0.001); Maternal Structuring (κ=.77, p<0.001); Maternal Nonintrusiveness (κ=.72, p<0.001); Maternal Nonhostility (κ=.82, p<0.001); Child Responsiveness (κ=.87, p<0.001); Child Involvement (κ=.64, p<0.001). For partners, inter-rater reliability on individual dimensions of the EA Scales is as follows: Paternal Sensitivity (κ=.76, p<0.001); Paternal Structuring (κ=.70, p<0.001); Paternal Nonintrusiveness (κ=.64, p<0.001); Paternal

Nonhostility (κ=.83, p<0.001); Child Responsiveness (κ=.74, p<0.001); Child Involvement (κ=.60, p<0.001).

Depression

The Edinburgh Postnatal Depression Scales (EPDS) was used to assess maternal and paternal depression at 8-weeks postpartum (Cox, Holden, & Sagovsky, 1987). The EPDS asks women to rate their mood over the previous seven days. Scores range from zero to three with a maximum summed score of 30. Higher scores indicate more depressive symptoms. Cronbach alpha was 0.82.

Stress and Anxiety

The short-form of the Depression and Anxiety Stress Scales (DASS-21) (Lovibond, 1995) was completed by mothers and partners at 8-weeks postpartum. The DASS-21 subscales each consist of 7-items (range: 0-21 multiplied by two). Participants rated the extent to which they had experienced each state *over the past week* on a 4-point scale (0= Never, 1= Sometimes, 2= Often and 3= Almost always). Cronbach alpha for the overall scale was 0.80.

Substance use

Quantity and frequency of maternal and paternal alcohol and tobacco use was collected at 8-weeks postpartum. Frequency of substance use was coded as: everyday; 5-6 times a week; 3-4 times a week; 1-2 times a week; 2-3 times a month; once a month; once or twice during the 3-month period. Alcohol use was recorded in standard drinks (10 grams of alcohol) per week. Tobacco use was recorded as number of cigarettes per day.

Statistical analysis

All data were analysed using the Statistical Package for Social Sciences (SPSS) 24. Mean parent-infant self-reported bonding scores for mothers and partners were calculated at 8-weeks postnatal. First, descriptive statistics were run for mother and partner-infant bonding, substance use and mental health postnatally (8-weeks). Next, two individual multiple linear regression models were run for mothers and partners with the variables measured at 8-weeks entered as predictor variables and EA at 12-months as the dependent variable. Reliability analyses were conducted using the ICC for the overall Global Total scale while Cohen's Weighted Kappa (Cohen, 1968) was used for the individual EA dimensions (ordinal variables). Values for Kappa <0.20 represent poor agreement, <0.40 fair agreement, <0.60

moderate agreement, <0.80 good agreement and above 0.80 represent very good agreement (Landis & Koch, 1977).

Finally, given the lack of independence between mother-partner dyads, Generalised Estimating Equations (GEE) was utilised as a regression analysis predicting parent (mother and partner) EA at 12-months (Liang & Zeger, 1993). GEE is a flexible approach to handling correlated data structures such as the dyadic mother-partner relationships found in this study. GEE allows analysis with: normal and non-normal dependent variables, dependent variables that are linearly or non-linearly linked to independent variables and full factorial models with any combination of discrete and continuous independent variables (Homish, Edwards, Eiden, & Leonard, 2010). An unstructured correlation matrix was chosen to avoid assumptions about how or whether the nested data were related. The within-dyad correlation was 0.42 with the dependent variable specified as EA and independent variables specified as: age; country of birth; SEIFA; employment status; baby gender; 8-week bonding; substance use (alcohol and tobacco) and mental health (stress, anxiety, depression).

Missing data

Person mean substitution (PMS) was conducted to impute missing data for the MPAS variables in the present research (Huisman, 2000). In this procedure, the imputed value for a variable with missing data was applied to cases with <20% of data missing on the scale and derived from the non-missing items for the case (Hawthorne & Elliott, 2005). When PMS was performed on this dataset, two participants were excluded due to missing data on the MPAS scale. There were also a number of participants with missing data for other variables. The presence of missing data raises the possibility of introducing bias into the results if data are not missing completely at random. In order to counter this, multiple regression analyses were carried out using multiple imputations of chained logit and mlogit equations to impute missing data.

Results

Descriptive results

Demographic and postnatal

Table 1 summarises the demographic characteristics of the sample, including mothers and partners. The mean age of mothers was 32-years (range: 19-46) and 35-years for partners

(range: 20-54). Using SEIFA categories (low, medium, high), the majority of families were high SES (69%) and married (71%). For over a third of the mothers (45%) this was their first pregnancy and the majority reported having wanted to become pregnant (86%). On average, infant birth weight was 3.45kgs and gestation was 39-weeks.

Study Measures

Summary statistics of the self-report measures utilised in this study (MPAS, DASS and EPDS) and the EA scale descriptive statistics are shown in Table 2. Table 3 details the summary statistics for parental substance use at 8-weeks postnatal. Frequency and quantity of alcohol scores were combined into a continuous scale, representing standard drinks per week. Tobacco was reported as cigarettes per day.

Given the low number of smokers in the current sample, a series of comparisons were run between smokers and non-smokers. Those who smoked were more likely to be younger ($t(300)=1.27$, $p=.213$), less educated ($n=302$ χ^2 $(4) = 50.60$, $p< .001$), have lower SEIFA scores ($t(300)= 2.87$, $p= .771$), and were less likely to be employed full time ($n=302$ χ^2 $(5)= 28.67$, $p<.001$). No difference was found between smokers and non-smokers in their country of birth ($n=302$ χ^2 $(2)= 1.29$, $p=.525$). For partners, those who smoked were more likely to be younger ($t(179)=1.57$, $p=.19$), educated ($n=187$ χ^2 $(4)= 24.27$, $p<.001$) and were more likely to have lower SEIFA scores ($t(189)= .68$, $p=.503$). No difference was found between smokers and non-smokers on the variables country of birth ($n=191$ χ^2 $(2)= .29$, $p=.877$) and employment status ($n=182$ χ^2 $(5)= 2.97$, $p=.702$).

Regression analysis

Two separate multiple regression analyses were conducted for mothers and partners separately using bonding, substance use and mental health at 8-weeks post-birth as predictor variables, and EA at 12-months as the dependent variable (See Table 4). The models adjusted for demographic and postnatal covariates, which included: age (years); country of birth; employment status; SEIFA and baby gender. Overall, the amount of variance, including demographic and postnatal factors, following adjustment was 19% (44% unadjusted) for the mother-infant EA model and 17% (42% adjusted) for the partner-infant EA model. Tobacco use at 8-weeks was coded as a binary variable (yes/no).

The first multiple regression analysis revealed that older maternal age significantly predicted stronger mother-infant EA at 12-months (t = 3.67, p<.001), after controlling for other demographic and postnatal covariates. Maternal tobacco use predicted poorer mother-infant EA at 12-months (t = -2.52, p<.01). In regard to partners, medium (t = 2.07, p<.05) and high (t = 2.16, p<.05) SEIFA scores predicted stronger EA while paternal tobacco use predicted poorer partner-infant EA at 12-months postnatal (t = -3.18, p<.001).

Generalised Estimating Equations (GEE) were then utilised to examine predictors of parent-infant (mother-infant and partner-infant combined) EA at 12-months. Results for the GEE analysis on parent-infant EA are presented in Table 5. Utilisation of GEE increased the number of observations in the analysis from n=191 (in the individual regression analyses) to n=350 (in the GEE analysis), providing greater power available for the analysis, while controlling for clustering due to the non-independence of observations by different parents of the same child. Older parent age was a significant predictor of higher parent-infant emotional availability at 12-months postnatal (χ^2= 6.28, p<.01). Parental tobacco use (χ^2=7.35, p<.01) and depression (χ^2= 4.51, p<.05) significantly predicted poorer parent-infant EA at 12-months postnatal.

Discussion

This novel study sought to address important gaps in the EA literature by examining a range of factors thought to be associated with EA in infancy, including both mother- and partner-dyads. The final GEE model revealed younger parent age, tobacco use and depression were each associated with lower parent emotional availability scores at 12-months. While past research has focussed on mother-child dyads (Biringen et al., 2014), we were able to demonstrate this relationship in a large sample of Australian parents. Understanding key predictors of parental-child EA at infant age 12-months is a foundational step in determining early indicators for intervention. These results suggest that preventive interventions to enhance EA might be targeted to parents who report tobacco use or elevated symptoms of depression (markers of emotional dysregulation) and to parents who are younger in age. Our study also adds to the existing literature by using observational data and a longitudinal design to examine predictors of EA in both mothers and partners when their infants reach 12-months of age.

Demographic variables

There were two sociodemographic variables that emerged as significant predictors of EA: age and relative socio-economic advantage and disadvantage (SEIFA). Namely, lower maternal age was associated with lower maternal EA at 12-months, while lower partner SEIFA scores (greater disadvantage) were associated with lower paternal EA. Lower parental age was associated with lower parental scores in the final GEE model accounting for dyadic correlation. Few studies have looked at sociodemographic characteristics and their association with EA, particularly with partners. One study with a similar sample size (n=220) found a similar relationship with age, namely; older maternal age was associated with higher EA (Bornstein et al., 2008). However, the current study extended Bornstein's work by comprehensively assessing EA at 12-months with a range of sociodemographic, postnatal, mental health and substance use variables in both mothers and partners. Other studies have shown associations between younger parental age and greater risk for adverse outcomes such as poorer reproductive outcomes (Fraser, Brockert, & Ward, 1995), early school leaving, unemployment, early parenthood and violent offending (Jaffee, Caspi, Moffitt, Belsky, & Silva, 2001). It may be that younger parents are less prepared for caregiving; that is, they may have had less time to become financially stable (Bornstein, 2002; Bunting & McAuley, 2004; Jaffee et al., 2001); they may be emotionally less mature; or, they may not have developed appropriate knowledge about child development (Barret & Robinson, 1981; Biello, Sipsma, & Kershaw, 2010; Elster, McAnarney, & Lamb, 1983; Neville & Parke, 1997). Given the potential risks to the infant associated with younger parental age, targeted support for younger parents through early intervention and public health initiatives would benefit equipping parents with practical caregiving skills and specific strategies designed to enhance the emotional connection in parent-infant relationships.

With respect to socio-economic status, it is likely that children living in higher SES settings have access to more resources to support their development. In contrast, parents in lower SES settings may need to focus greater attention on practical needs for their children and may struggle to also maintain focus on the emotional needs of their children (Bornstein & Bradley, 2014). Our work is consistent with previous research that has documented less optimal EA scores among dyads characterised by lower socio-economic status (Chaudhuri, Easterbrooks, & Davis, 2009; Little & Carter, 2005; Ziv et al., 2000). Given our comprehensive assessment of EA prediction at 12-months postnatal in a larger sample of

families, these findings offer a unique and valuable contribution to the literature, and respond to recent calls for further understanding of socio-economic pressures on parental caregiving (Feeney, 2016).

Early bonding

Contrary to expectations, our results did not support the association between early self-reported parent-infant bonding (at 8-weeks) and EA at 12-months of age. This study sought to understand how self-report and observational methods would provide unique or complementary information on parent-infant relationship quality at 12-months. The results indicate that self-reported bonding and EA may capture different aspects of the mother-infant relationship, in line with the view that self-report and observational assessments do not necessarily yield comparable outcomes (Bornstein, 2002; Vliegen et al., 2009). In developing the Maternal Postnatal Attachment Scale, Condon's focus was primarily on maternal affective responses to her infant (rather than beliefs or attitudes) in a number of dimensions relating to mother-infant bonding (Condon & Corkindale, 1998). In contrast, EA refers to the capacity of a dyad to share an emotionally healthy relationship (Biringen, 2008; Biringen, Robinson, & Emde, 1998). EA includes the child in the interaction, as such, it is possible that child-related factors account for the lack of association between bonding and EA in this study. In addition to measurement considerations, there is also evidence to suggest that the postnatal parent-infant relationship is *dynamic*, with indicators of the bond at 8-weeks changing by 12-months (Condon & Corkindale, 1998; Condon et al., 2008). This might provide an alternate explanation for this result. Bowlby describes the attachment relationship as goal-corrected (Bowlby, 1969/1980, 1973), whereby the parent and infant respond transactionally over time to each others' cues. Thus, the relationship as measured at 8-weeks post-birth by the self-reported bond might be qualitatively different to the relationship assessed by the EA Scales at 12-months postnatal. Finally, it may be the case that parents' perceptions and ratings of their affective bond assess a critical introspective appraisal not captured by observational tools (Condon, 2012). Further research using a multi-method approach, inclusive of the EA dimensions, is recommended to better understand how bonding and EA are associated and how they contribute empirically to the measurement of parent-infant relationship quality.

Mental health

Associations were examined between mental health in both mothers and partners at 8-weeks postnatal and EA at infant age 12-months. After adjusting for dyad clustering, the results show that symptoms of parental depression at 8-weeks were associated with lower parent-infant EA scores at 12-months. In separate regression analyses the maternal depression and EA association was marginally non-significant (p=.06); however, with the increased power in the dyadic analysis, the effect of depression reached significance. This work may help to clarify past inconsistencies in similar investigations. Namely, the current study suggests that depression, measured in either member of the parenting *dyad* (mother or father), allows more precision in predicting parent-child EA than depression associated with only one parent. Little research has examined the effects of both maternal and paternal depression on parent-child interaction, especially using the EA Scales. Related research investigating parenting practices and parent-child interactions has found that paternal depression during the postnatal period exacerbates the effects of maternal depression on later child behaviour problems but only if the father spends a significant amount of time caring for the child in infancy (Mezulis, Hyde, & Clark, 2004). In addition, being exposed to a nondepressed partner did not buffer the effects of maternal depression even if parents spent high amounts of time with their infants (Mezulis et al., 2004). Other work has also documented individual and combined effects of maternal and paternal depression on both each parent's own interactions with their child, and the interactions of their partner with their child (Paulson, Dauber, & Leiferman, 2006). In sum, the findings of the present study add to growing evidence supporting the role of partners in their infant's socio-emotional development both uniquely and via their supportive role to mothers, including those experiencing symptoms of depression in the postnatal period. Effect sizes in the GEE model were small and so represent only part of the influence on EA, but this preliminary work offers a valuable understanding of the partners role in the development and maintenance of emotional relationships with infants in the first year of life. Future work to distentangle maternal and paternal depression in the parenting dyad and interactions with parent-child EA is needed.

Substance use

This study also examined caffeine, alcohol and tobacco use in the early postnatal period and their association with EA at 12-months. As was hypothesised, tobacco use at 8-weeks postnatal was associated with lower EA scores in both mothers and partners at infant age 12-months. When GEE was performed on the clustered mother-partner dyads tobacco use remained associated with lower parent EA scores at 12-months. There are a number of

potential explanations for the relationship between tobacco use and EA. For instance, it is possible that markers of socio-demographic disadvantage commonly associated with tobacco smoking (i.e., low educational attainment, SEIFA or income) negatively impact the parent-infant relationship, including parental capacity for EA to the infant (Gilman et al., 2008; Hiscock, Bauld, Amos, Fidler, & Munafò, 2012). Yet careful control for several of these potential covariates suggests there may be alternate explanations. Another potential pathway between tobacco use and postpartum EA is through emotional suppression in the parent. Specifically, substance use, in this case tobacco use, has been linked to less optimal emotion regulation capacity and may represent a form of self-medication or avoidance of emotional awareness (Koole, 2009; Sloan et al., 2017). Thus, it might be the case that it is not tobacco use per se, rather, the parent may be less optimally available to affectively connect with, and co-regulate, the infant's emotional states (Field, 1994). It might also indicate a relationship in which the parent removes himself or herself from child proximity to smoke in order to protect the child from health repercussions, but in doing so reduces opportunities to demonstrate emotional availability. Future research would be beneficial in clarifying the association of substance use, emotion regulation and EA in parent-child relations. Given the small number of smokers in the present sample and lack of data on smoking behaviours in the presence of infants, caution should be exercised in interpreting these results. Further research would help elucidate the mechanisms for these relationships.

Strengths and limitations

Despite the strengths of the prospective design, rich observational data and use of GEE to manage dyadic clustering, there are some limitations to be considered in the context of this study. First, observational measurements can be prone to bias such as the "halo effect", where a coder will code all dimensions similarly high (or low) (Biringen et al., 2014). Nevertheless, the reliability and validity of the EA Scales have been demonstrated (Biringen, 2000; Bornstein et al., 2008; Ziv et al., 2000) and the inter-rater reliability for this study was in the acceptable range. Second, the current sample represents a somewhat advantaged group of families from NSW, predominantly Anglo-Saxon Australians. Nevertheless, comparisons with women who gave birth during the same period of time, but who had not completed all requisite measures, showed similar sociodemographic characteristics. Moreover, the sample is similar to the Australian population of women giving birth in 2012 (Hilder et al., 2014) on a range of demographic and birth factors. Finally, no substance use or mental health data was

collected at 12-months to control for concurrent levels of these variables which may partially account for some of the relationships identified.

Conclusion

In this unique study, 191 matched mother-partner-infant triads were assessed longitudinally over the first year of life to comprehensively examine predictors of emotional availability at 12-months, controlling for dyadic correlation and a range of sociodemographic and postnatal variables. The results of this study indicated that lower maternal age is associated with lower maternal EA at 12-months, while lower partner SEIFA scores were associated with lower paternal EA. Tobacco use was associated with lower EA in mothers and partners. In the final GEE model, accounting for dyadic clustering, younger parent age, tobacco use and depression were each associated with poorer parent emotional availability at 12-months. The findings suggest that it may be particularly important to support young couples and those struggling with symptoms of depression or tobacco use during the postnatal period in order to strengthen parent emotion regulation and the parent-child relationship. Further research with partners would help to elucidate these patterns further.

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Tables

Table 1: *Sample demographic and obstetric characteristics*

Characteristic	Mothers		Partner	
	n	**Mean (*SD*[a])**	**n**	**Mean (*SD*)**
Pregnancy (Third trimester)				
Mean age (years)	191	32.41 (*4.77*)	181[b]	34.79 (5.95)
	n	**%**	**n**	**%**
Marital status				
Married or de facto	189	99.00	-	-
No partner or not living with partner	2	1.00	-	-
Employment status				
Full time	99	51.80	163	85.30
Part time/casual	43	22.50	12	6.30
Unemployed/student/home duties	49	25.70	7	3.60
SES (SEIFA)				
Low	5	2.60	-	-
Medium	54	28.30	-	-
High	132	69.10	-	-
Highest level of education				
Completed Year 10	7	3.70	15	7.90
Completed Year 12	12	6.30	27	14.10
Completed TAFE/Technical	24	12.60	34	17.80
Completed University/College	147	77.00	104	54.50
Country of birth				
Australia	106	55.50	102	53.40
Other English Speaking Country (OESC)	34	17.80	42	22.00
Non English Speaking Background (NESB)	51	26.70	38	19.90

Indigenous				
Aboriginal and/or Torres Strait Islander	2	1.00	1	0.50
Non Aboriginal Torres Strait Islander	189	99.00	181	94.80
Living Arrangement				
Renting	93	48.70	-	-
Privately own	89	46.60	-	-
Staying with friends/family	7	3.70	-	-
Other	2	1.00	-	-
Pregnancy				
Wanted to become pregnant	164	85.90	-	-
Didn't want to become pregnant	6	3.10	-	-
Hadn't thought about becoming pregnant	12	6.30	-	-
Other	9	4.70	-	-
First pregnancy				
Yes	85	44.50	-	-
No	106	55.50	-	-
Postnatal (8-weeks)	**n**	**Mean *(SD)***	**n**	**%**
Baby's birth weight (kg)	187	3.45 (*0.50*)	-	-
Gestation at birth (weeks)	187	39.38 (*1.44*)	-	-

[a] *SD: Standard deviation from the mean.*

[b] *n=5 same sex partners*

- : Partner data not available or refer to mother data

Please note: Numbers varied due to missing data

Table 2: *Summary statistics of study measures postnatally*

	Mothers					Partners				
	n	Mean	SD	Range		n	Mean	SD	Range	
				Min	Max				Min	Max
Bonding (Mothers: MPAS, Partners: PPAS)										
8-weeks	183	84.26	5.82	64.15	95.00	189	71.05	6.72	46.50	85.00
12-months	177	83.83	5.93	64.00	95.00	176	70.29	6.66	48.40	83.60
Mental health (8-weeks)										
Stress (DASS)	187	6.77	5.75	0.00	24.00	190	6.28	6.13	0.00	32.00
Anxiety (DASS)	187	1.35	2.46	0.00	14.00	190	1.39	2.45	0.00	16.00
Depression (EPDS)	186	3.86	3.47	0.00	19.00	190	3.83	3.68	0.00	18.00
Emotional Availability (12-months)										
Adult sensitivity	191	25.93	2.69	15.00	29.00	191	25.26	2.82	11.00	29.00
Adult structuring	191	24.83	3.22	12.00	29.00	191	23.51	3.98	11.00	29.00
Adult non-intrusiveness	191	25.53	3.02	12.00	29.00	191	24.95	2.57	14.00	29.00
Adult non-hostility	191	28.48	1.41	19.00	29.00	191	28.52	1.71	12.00	29.00
Child responsiveness	191	25.48	2.81	14.00	29.00	191	25.60	2.59	16.00	29.00
Child involvement	191	22.20	4.06	10.00	29.00	191	21.72	3.67	9.00	29.00
Overall total	191	86.13	9.20	40.00	100.00	191	84.81	8.66	51.00	100.00

Please note: Numbers varied due to missing data on that particular variable

Table 3: *Summary statistics of substance use (alcohol and tobacco) at 8-weeks postnatal*

	Number of respondents	Number using substance	Quantity consumed			Range	
	n	n (%)	Mean	Mode	SD	Min	Max
Mothers							
Alcohol	187	118 (61.80)	2.04	0.00	3.56	0.00	21.00
Tobacco	187	10 (5.20)	7.90	3.00	8.85	1.00	30.00
Partners							
Alcohol	190	153 (80.10)	7.17	0.00	9.35	0.00	42.00
Tobacco	191	39 (20.40)	5.41	10.00	3.87	1.00	15.00

Please note: Numbers varied due to missing data on that particular variable

Table 4: *Regression analyses predicting mother and partner emotional availability at 12-months (N=191)*

	Mother EAS 12-months				Partner EAS 12-months			
	B	***β***	***t***	***p***	**B**	***β***	***t***	***p***
Demographic variables								
Age	0.56	0.28	3.67	0.00***	0.19	0.13	1.75	0.08
Country of birth								
Australia (reference)								
OESC	0.95	0.04	0.51	0.61	1.37	0.07	0.88	0.38
NESB	1.96	0.09	1.18	0.24	2.62	0.12	1.48	0.14
Employment status								
Full-time (reference)								
Part-time	-1.58	-0.07	-0.93	0.35	0.52	0.01	0.20	0.84
Other[a]	-0.40	-0.02	-0.25	0.80	-3.23	-0.07	-1.00	0.32
SES (SEIFA)								
Low (reference)								
Medium	3.85	0.18	0.57	0.57	18.23	0.97	2.07	0.04*
High	4.86	0.24	0.73	0.47	19.04	1.01	2.16	0.03*
Postnatal variables								
Baby gender (0=Male, 1=Female)	2.28	0.12	1.69	0.09	0.96	0.06	0.75	0.46
8-week predictors								

Postnatal bonding score	-0.04	-0.02	-0.28	0.78	-0.01	-0.01	-0.11	0.91
Alcohol	0.07	0.03	0.36	0.72	0.10	0.11	1.38	0.17
Tobacco	-7.78	-0.18	-2.52	0.01**	-5.31	-0.26	-3.18	0.00***
Stress	0.19	0.12	1.19	0.23	0.03	0.02	0.20	0.84
Anxiety	-0.31	-0.08	-0.92	0.36	0.38	0.11	1.25	0.21
Depression	-0.53	-0.19	-1.92	0.06	-0.38	-0.16	-1.51	0.13
		R^2=0.44 (R^2_{adj}=0.19)				R^2=0.42 (R^2_{adj}=0.17)		
		F=2.76				F=2.18		
		p< .001				p< .001		

** p< .05. ** p< .01. *** p< .001.* [a] *Unemployed/student/home duties*

Table 5: *GEE analysis predicting parent emotional availability at 12-months*

	Mother and partner EAS 12-months (N=348)							
	B	**95% CI**		***β***	**95% CI**		χ^2	***p***
		Lower	***Upper***		***Lower***	***Upper***		
Demographic variables								
Age	0.27	0.06	0.49	1.32	1.06	1.63	6.28	0.01**
Country of birth								
Australia (reference)								
OESC	1.14	-0.96	3.24	3.13	0.38	25.57	1.13	0.29
NESB	1.79	-0.36	3.93	5.96	0.70	50.97	2.66	0.10
Employment status								
Full-time (reference)								
Part-time	-1.37	-3.98	1.24	0.25	0.02	3.45	1.06	0.30
Other†	-1.06	-3.43	1.30	0.35	0.03	3.67	0.78	0.38
SES (SEIFA)								
Low (reference)								
Medium	8.87	-6.57	24.31	7111.66	0.00	3.60×10^{10}	1.27	0.26
High	9.75	-5.79	25.28	17088.09	0.00	9.53×10^{10}	1.51	0.22
Parent								
Partner (reference)								
Mother	-1.99	-4.23	0.25	0.14	0.01	1.29	3.02	0.08
Postnatal variables								
Baby gender	1.85	-0.25	3.95	6.35	0.78	51.82	2.98	0.08

(0=Male, 1=Female)								
8-week predictors								
Postnatal bonding score	0.01	-0.12	0.14	1.01	0.89	1.16	0.03	0.86
Alcohol	0.09	-0.02	0.20	1.10	0.98	1.23	2.79	0.09
Tobacco (0=No, 1=Yes)	-3.98	-6.85	-1.10	0.02	0.00	0.33	7.35	0.01**
Stress	0.11	-0.08	0.30	1.12	0.92	1.35	1.28	0.26
Anxiety	-0.04	-0.46	0.37	0.96	0.63	1.45	0.04	0.84
Depression	-0.35	-0.68	-0.03	0.70	0.51	0.97	4.51	0.03*

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

CI: Confidence Interval

λ^2 *: Wald chi-square*