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Breastfeeding, Parenting, and Infant Attachment Behaviors

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Abstract
Objectives Infants and toddlers need secure attachments in order to develop the social competence required to successfully navigate later peer and adult relationships. Breastfeeding is a parenting factor that has been associated with child emotional development—specifically the attachment between children and their mothers. Yet, this link may simply be the result of other parenting behaviors that are associated with breastfeeding. Thus, our objective is to examine whether the link between infant attachment behaviors and breastfeeding endures when accounting for a broad array of in-depth measures of parenting. *Methods* We use the Early Childhood Longitudinal Study of children from 9 months to 2 years of age collected by the National Center for Education Statistics. Using Ordinary Least Squares regression, data analyses examine the association between the Toddler Attachment Sort-45 (TAS-45) measures of toddler-parent attachment (infant attachment security and temperamental dependency) and breastfeeding practices. We also examine individual items of the TAS-45 to isolate specific attachment behaviors that have the strongest associations with breastfeeding. *Results* We find an enduring link between children who are predominantly breastfed for six or more months and infant attachment security. However, we find no evidence that breastfeeding is linked to a child's temperamental dependency. Of the nine items used to examine infant attachment behaviors, we find that breastfed children are rated as having slightly higher scores on two measures ("warm and cuddly," "cooperative") and lower scores on one measure ("demanding/angry"). *Conclusions for Practice* Breastfeeding has an important link to the child's use of their caregiver as a secure base for exploration and a place of comfort when distressed (infant attachment security). Yet, breastfeeding does not appear to reduce a child's temperamental dependency or level of clinginess as measured by how demanding, fussy or distressed the child becomes when separated.

Keywords Breastfeeding · Infant security attachment · Temperamental dependency · Cognitive development · Mother-infant bond

Abbreviations

TAS-45	Toddler Attachment Sort-45
ECLS-B	Early Childhood Longitudinal Study-Birth Cohort
NCES	National Center for Education Statistics
OLS	Ordinary Least Squares
HOME	Home Observation for Measurement of the Environment
CES-D	Center for Epidemiologic Studies Depression Scale

Significance

What's Known on This Subject? A child's attachment behaviors in early childhood influences later social competence and school readiness.

What This Study Adds? It is unclear whether or not breastfeeding influences infant attachment security and temperamental dependency independent of other parenting behaviors. We find a modest but direct relationship between predominant breastfeeding a child for six or more months and infant attachment security, but no relationship to temperamental dependency.

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Introduction

Although breastfeeding is positively associated with numerous child outcomes (Rogers and Blissett 2017; Julvez et al. 2007), the underlying mechanisms for its link have often been debated (Lind et al. 2014; Else-Quest et al. 2003). One important way that breastfeeding matters is that the mother forms important attachments with the child which then benefit the child's socio-emotional development (Julvez et al. 2007). And as other feeding methods do not demand as much mother/child time (Smith and Ellwood 2011) this can limit the mother's ability to actively respond to the child's feeding cues (Shloim et al. 2015, 2016). As breastfeeding has demonstrable advantages over other feeding methods (Rogers and Blissett 2017; Shloim et al. 2015), it is unclear to what extent breastfeeding matters for child attachment when accounting for other parenting behaviors that are also associated with breastfeeding.

As Gibbs and Forste show with cognitive development (Gibbs and Forste 2014a), the link between breastfeeding and early childhood math and reading skills is fully mediated by parenting practices that directly promote school readiness. In other words, breastfeeding is a proxy for the kinds of parenting behaviors that often co-occur with breastfeeding. Although this mediation model has been demonstrated for early math and reading outcomes, it is unclear whether breastfeeding *directly* promotes infant attachment security and temperamental dependency (Britton et al. 2006) or if mothers who breastfeed also engage in other parenting behaviors that promote attachment. In this study, we examine if breastfeeding has an enduring, direct link to the child's attachment behavior after accounting for a broad-array of parenting behaviors that are often associated with infant attachment behaviors.

Infant Attachment Security and Temperamental Dependency

As first developed by the psychiatrist Bowlby (1969), attachment theory posits that the primary function of a child's bond with parents or caregivers is to provide a secure, safe base from which the child can then explore their surrounding environment. In moments of stress or fear, children will respond in various ways depending upon the kind of attachment relationship they have with a primary caregiver (Fearon et al. 2015). Currently, there are four types of attachment security as defined by the literature, namely avoidant, secure, resistant and disorganized (Fearon et al. 2015). Each type of attachment security is associated with certain child behaviors and have been shown to be reliably measured across studies (Spieker et al. 2009). In this study, we examine how breastfeeding is associated with secure attachment (as compared to avoidant, resistant, and disorganized types).

We also explore a related phenomenon—child temperament. Child temperament, or temperamental dependency, is marked by separation-distress proneness (Belsky and Rovine 1987; Stupica et al. 2011). Children with high levels of temperamental dependency are often clingy, demanding, and fussy, and exhibit excessive distress upon separation (Roisman and Fraley 2008). It should be noted that temperamental dependency is weakly associated with attachment security (Groh et al. 2016), suggesting that this is an important construct of attachment that provides a related but separate assessment of a child's attachment beyond infant attachment security.

These forms of parent–child attachment have been linked to increased socio-emotional skills of children—including early mother-infant bonding (Else-Quest et al. 2003) and a child's readiness for school (Julvez et al. 2007; Rispoli et al. 2013; Bernier et al. 2012, 2015; Drake et al. 2014). Children with secure attachments are better able to read perceptual cues and trust claims, even from strangers, than are insecure children (Corriveau et al. 2009). Secure infant attachments allow children to later explore and be sociable with unfamiliar adults. Highly irritable and insecurely attached infants are less likely to explore, and are less sociable as toddlers relative to other infants (Stupica et al. 2011; Heikkilä et al. 2011).

Parent–child attachments have also been found to be associated with later outcomes in life (Bohlin et al. 2005). Attachment security of a toddler to their mother is positively associated with a child's executive functioning in kindergarten (Bernier et al. 2015). Maternal sensitivity, which is also associated with attachment security (Rispoli et al. 2013), has been found to have an enduring association on social and academic competencies long into adulthood (Raby et al. 2015; Fraley et al. 2013). As parent–child attachments are strongly associated with a variety of social and cognitive outcomes, it is of vital importance to understand how attachments between infant and caregiver are developed.

Breastfeeding as Proxy

One way that parent–child attachment may form is through breastfeeding. Breastfeeding is a parenting behavior that has been associated with child emotional development. Various studies have found associations between breastfeeding and later socio-emotional development in children (Julvez et al. 2007; Heikkilä et al. 2011; Oddy et al. 2010). More specifically, utilizing data from intensive time-use diaries, Smith and Ellwood (Roisman and Fraley 2008) found that exclusively breastfed infants received substantial amounts of emotional care from their mothers, more so than formula fed

infants, or even mixed fed infants. Hence, intensive breastfeeding may facilitate increased maternal emotional care resulting in greater security attachment.

Using fMRI scanning, Kim et al. (2011) examined the associations between breastfeeding, maternal brain response to infant stimuli, and maternal sensitivity. Their findings indicate links between breastfeeding and greater response to infant cues in brain regions related to maternal-infant bonding and empathy. Thus, brain activation in response to infant stimuli may facilitate greater maternal sensitivity–which is related to increased security attachment in children.

Despite these findings, Lind et al. (2014) recently concluded that associations between breastfeeding and later psychosocial development disappear once confounding factors, such as maternal socio-demographic measures are controlled for Belfort et al. (2016). In this way, breastfeeding may simply be a proxy for other related parenting behaviors that more directly link to infant attachment security and child temperamental dependency. Else-Quest et al. caution (2003), however, that it is the quality of the mother-infant relationship that is important, not the feeding method. For example, as Britton et al. (2006) find no direct relationship between attachment security and breastfeeding, they conclude that mothers who decide to breastfeed show enhanced sensitivity during infancy, which in turn may then promote secure attachment.

To date, what is known about the link between breastfeeding and security attachment has largely been derived from regional, selective data with few measures of parenting. Our contribution is to examine the link using first-of-its-kind national longitudinal data with in-depth measures of parenting. We present a simple conceptual model where we explore whether other parenting measures will explain the relationship between breastfeeding and child attachment behaviors (see Fig. 1). We anticipate that (1) predominantly breastfeeding for six or more months will be positively associated with infant attachment security and negatively associated with temperamental dependency; (2) we expect that other parenting will not mediate this link; and (3), we expect that the subtest measures of attachment will reveal that not all items have the same relationship to breastfeeding.

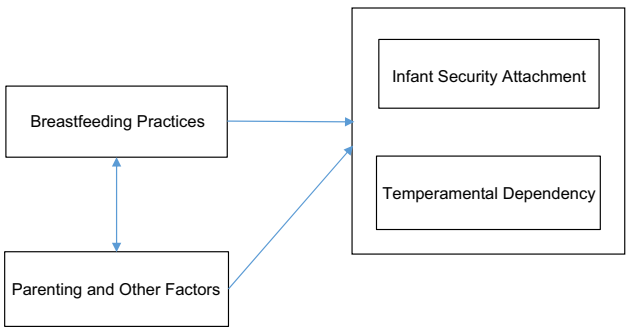

Fig. 1 Conceptual model of breastfeeding and attachment outcomes with parenting as a cofounding measure

In our analyses, we model the relationship between breastfeeding and child-parent attachment (security and temperamental dependency) based on early childhood longitudinal data. Then, we account for a wide array of parenting measures that might confound the breastfeeding/attachment link. Finally, we explore a subset of attachment measures to explore which specific forms of attachment are most closely associated with breastfeeding.

Method

Sample

We use the Early Childhood Longitudinal Study (ECLS-B) of children from 9 months to kindergarten collected by the National Center for Education Statistics (NCES) (Nord et al. 2006). The ECLS-B followed a nationally representative sample generalizable to American children born in 2001 (Flanagan 2004; Mulligan and Flanagan 2006). We use data collected at 9 months of age (2001–2002) and 2 years (2003–2004). The original sample at wave 1 was about 10,900 children and their mothers (a response rate of 74.1%), but because of attrition, dropped to 9800 by wave 2 (a 10% attrition rate). Because we excluded cases where the child's caregiver was not the biological mother and multiple births beyond twins our final sample resulted in 8900 children. In accordance with NCES guidelines, numbers are rounded to the nearest 50.

Data Analysis

All analyses were performed in StataSE 14. Because the dependent variables were continuous we used Ordinary Least Squares (OLS) regression. Missing data ranged from 0 to 17% (see Table 1). To account for missing cases, we used the *mi* function in Stata to run imputed files simultaneously. We made adjustments for sample clustering and applied appropriate sample weighting.

Descriptive statistics are presented with and without sample weights to report both the qualities of the generalized US population (weighted data) and the characteristics of the data (unweighted data). Comparing weighted and unweighted means reveals the impact of oversampling techniques on some of the selected measures (see Table 1).

Infant Attachment Behavior

We used two composite measures of infant attachment behavior measured at the home visit when the child was 2 years of age (Roisman and Fraley 2008). Both measures

Table 1 Descriptive statistics by weighted and unweighted sample means, ECLS-B, 2001 (n = 8900)

	% Missing	Weighted mean	Mean	SD	Range	
Infant security attachment	2	0.45	0.43	0.36	−0.86	1.47
Temperamental dependency	2	−0.13	−0.12	0.32	−0.88	0.89
Subfactors						
Warm and cuddly	2	0.30	0.30	0.30	−0.77	1.32
Cooperative	2	0.39	0.37	0.35	−0.75	1.29
Enjoys company	2	0.21	0.19	0.39	−0.84	1.31
Independent	2	0.16	0.15	0.32	−0.77	0.98
Attention seeker	2	−0.08	−0.07	0.24	−0.68	0.70
Upset by seperation	2	−0.14	−0.13	0.25	−0.78	0.77
Avoids others	2	−0.01	0.00	0.27	−0.76	0.80
Demanding/angry	2	−0.13	−0.12	0.26	−0.87	0.75
Moody/unusual	2	−0.59	−0.57	0.53	−1.94	1.37
Infant feeding practices						
Predominantly breastfed 6 + months	1	0.17	0.11	0.31	0.00	1.00
Predominantly breastfed 3–5 months	1	0.12	0.15	0.36	0.00	1.00
Predominantly breastfed < 3 months	1	0.71	0.74	0.44	0.00	1.00
Introduced to solid foods < 4 months	0	0.24	0.21	0.43	0.00	7.57
Put to bed with bottle	0	0.30	0.31	0.46	0.00	1.00
Parenting measures						
Frequency of reading (wave 1)	0	2.74	2.70	1.03	1.00	4.00
Frequency of reading (wave 2)	0	3.13	3.12	0.90	1.00	4.00
Cognitive stimulation (wave 2)	17	4.09	4.04	1.07	0.07	8.03
Maternal sensitivity (wave 2)	17	4.75	4.70	0.94	0.72	7.75
Maternal warmth (wave 2, Cronbach's alpha .631)	5	0.02	0.00	0.85	−4.94	0.22
Household characteristics						
Socioeconomic status	0	−0.08	−0.03	0.86	−2.13	2.18
Mother's education level	0	4.19	4.33	1.96	0.18	9.00
Daycare	0	0.09	0.09	0.29	0.00	1.00
Sibling size	0	0.99	1.09	1.14	0.00	9.00
Both biological parents in home	0	0.84	0.84	0.74	0.00	9.00
Child characteristics						
Race/ethnicity						
White	0	0.53	0.43	0.49	0.00	1.00
Black	0	0.14	0.16	0.37	0.00	1.00
Hispanic	0	0.25	0.20	0.40	0.00	1.00
Asian	0	0.03	0.10	0.30	0.00	1.00
Other	0	0.05	0.11	0.32	0.00	1.00
Birthweight						
Normal	0	0.93	0.74	0.44	0.00	1.00
Moderate	0	0.06	0.16	0.36	0.00	1.00
Low	0	0.01	0.10	0.30	0.00	1.00
Twin	1	0.03	0.16	0.37	0.00	1.00
Gestation age	2	38.75	37.46	3.84	17.00	47.00
Female	0	0.49	0.49	0.50	0.00	1.00
Mother characteristics						
Depression	6	−0.02	0.00	0.98	−5.74	2.36
Body mass index	6	24.82	24.77	5.72	10.17	66.10
Age at child's birth	1	27.29	27.56	6.37	13.41	50.00
Smoked during pregnancy	0	0.11	0.11	0.32	0.00	1.00
Born in the U.S.	0	0.79	0.76	0.43	0.00	1.00

Weighted means calculated using pweight = w2c0, psu = w2cpsu, strata = w2cstr. Data are imputed for missing values. Missing calculated of sample after attrition and selection criteria

were assessed using the Toddler Attachment Sort-45 (TAS-45). As described in the NCES material, the following are representative items the interviewers were trained to observe: (1) when the mother asks child to do something, the child understands what she wants, (2) when child cries, the child cries loud and long, (3) the child is social and enjoys the company of others, (4) the child turns away from friendly adult strangers (i.e., the interviewer) if they come too close, and (5) if asked, the child lets friendly adult strangers (i.e., the interviewer) hold or share toys. The TAS-45 assessment was completed by the interviewer after the home visit on a laptop (Nord et al. 2006).

The first measure of attachment we assess, *infant attachment security*, rates the child's security with the mother, specifically assesses whether the child uses their caregiver as a secure base of exploration and a place of comfort when distressed. The second, *temperamental dependency*, rates the child's level of "clinginess," and whether the child appeared demanding, fussy or distressed (when separated) during the in-home observations. The TAS-45 measures of infant attachment security and temperamental dependency have been found to be both valid and reliable (Spieker et al. 2011; Andreassen and Fletcher 2007).

We also examined the specific items used to construct the socio-emotional behaviors that comprise the TAS-45. This includes the following measures: the child was "warm and cuddly" (child actively sought and enjoyed physical affection with parent), "cooperative" (child was compliant and cooperative with parent requests and suggestions), "enjoyed company" (child was sociable and enjoyed the company of others), "independent" (child was independent and self-sufficient—he or she explored freely), "attention seeking" (the child demanded attention), "upset by separation" (child became upset when mother moved away or out of site and was inconsolable without the mother), "avoided others" (child avoided people and played with objects (toys) and was "slow to warm up" to strangers), "demanding/angry" (child was quick to anger, tears, and or inconsolable after once crying), and "moody/unusual" (child displayed unusual behavior, changed moods quickly and or looked confused or dazed) (Nord et al. 2006). These TAS-45 specific measures can help clarify which aspects of the parent–child relationship are most closely associated with breastfeeding.

Breastfeeding

Given the American Academy of Pediatrics recommendation that infants be breastfed exclusively for 6 months (World Health Organization Web site 2017), we focused our analysis on predominant breastfeeding up to 6 months. We examined other ways to measure breastfeeding (number of months, different cut points and found similar results). Following World Health Organization guidelines, we use the term "predominant" over "exclusive" because we cannot specifically determine if the infant received other sources of nutrients from water-based drinks, fruit juices, or vitamin supplements (Ryan et al. 2004). When the child was 9 months of age, mothers were asked if they ever breastfed and for how many months. They were also asked (in a separate question) about formula feeding (in months). If the child had not been formula fed and was actively breastfed from 3 to 5 months, the mother's feeding practices were assigned as predominantly breastfeeding for 3–5 months. If the child was breastfed 6 months are more, this was categorized as predominant breastfeeding for 6 or more months. Therefore mothers who *did not* predominantly breastfeed for three months or more are the reference category.

We also consider other feeding practices. We created a dichotomous measure coded 1 if solids were given before 4 months of age, 0 otherwise. For bottle feeding at bedtime, the mother was asked at 9 months if the child was put to bed with a bottle, which we coded as a dichotomous measure (1 = yes and 0 = no).

Confounding Factors: Parenting

As Gibbs and Forste (2014a) find, many aspects of parenting are also associated with breastfeeding and could work to confound the relationship between breastfeeding and child development outcomes. Using this work as a guide, we include measures of parenting that may enhance parent–child attachment and be associated with breastfeeding. The ECLS-B data used several measures of the home environment from the National Household Education Survey and the Home Observation for Measurement of the Environment (HOME), as well as mother/child interactions derived from Ryan et al. (2004). We focused on four measures—the *frequency of reading to the child, maternal cognitive stimulation, maternal sensitivity*, and *maternal warmth*.

For *frequency of reading*, the mother was asked how frequently she (or any other family member) read books to the child in a typical week. Responses ranged from "not at all," "once or twice," "3–6 times," to "every day." This measure was assessed when the child was 9 months and again at 2 years of age. We include both in our analyses.

Also at 2 years, measures for *cognitive stimulation* and *maternal sensitivity* were collected. These parent/child interaction assessments were not based on a cognitive *test* of the parent or child but a *task* that required parent and child interaction. The assessment of parent–child interaction was developed from the Three Bags Task, a measure successfully administered in other large scale studies and is a semi-structured activity. The parent and child were videotaped while they engaged in the activities and the videotapes were coded and rated by Westat staff members trained in several global

scales of parent–child interaction. Nord and colleagues describe the assessments in more detail (Nord et al. 2006).

We used two of the parenting global scales (coded from 1 to 7, with 7 representing a high score) that focused on overall emotional supportiveness of the parent in providing cognitive stimulation: *parental stimulation of cognitive development* (the parent's effort in teaching to enhance perceptual, cognitive, and language development) and *parental sensitivity* (how the parent observes and responds to the child's cues including gestures, expressions, and signals). Given the evidence that the breastfeeding link to attachment security may be explained by high quality assessments of the child's learning environment, these measures provide an important contribution and are more detailed than measures used in past research (Rothstein 2012).

Finally, *maternal warmth* is an important part of a child's development (Brooks-Gunn and Han 2002; Guo and Harris 2000; Caldwell and Bradley 2001; Bradley et al. 1981). Radin defines "warmth" as the mother's use of (1) reinforcement, physical or verbal; (2) consultation with the child, or asking him to share in some decision; and (3) sensitivity to the child, or anticipating the child's requests or feelings (pp. 1561, 1971) (Bradley et al. 1981). In the ECLS-B, maternal warmth is derived from measures adapted from the Home Observation for Measurement of the Environment (HOME) scale. We identified three indicators of maternal warmth—*caress, kiss or hug the child, respond verbally to the child's speech;* and *spontaneously speaks to child*—from the interviewer observations of the home environment. These measures are consistent with the conceptualization and measurement of maternal warmth elsewhere (Caldwell and Bradley 2001; Gibbs and Forste 2014b; Brooks-Gunn et al. 1996). Alpha scores for these measures are modest at .64 with factors scores for *caress, kiss or hug the child, respond verbally to the child's speech* and *spontaneously speaks to child* and are consistent with other studies (Caldwell and Bradley 2001).

Household Characteristics

Because breastfeeding and attachment may be associated with socioeconomic and related advantages in the United States (Gibbs and Forste 2014a), we included other potentially confounding factors associated with advantage and disadvantage. Family *socioeconomic status* was measured by a composite scale consisting of household income, parental education and occupational prestige created by the NCES. The measure is normalized with a mean of zero. Family structure was a dichotomous measure coded 1 if the child was living with both biological parents at 9 months, and 0 if otherwise; the number of siblings in the household was also included. Because maternal education is closely tied with a child's development we also include the mother's highest level of education. We also account for other control variables including regular daycare attendance measured at 9 months of age (1 = yes, 0 = no), s*ibling size* (count of siblings 0–9), and *both biological parents in home* (1 = both parents, 0 = all other arrangements).

Child Characteristics

Child characteristics may influence breastfeeding practices and parent–child attachments (Gibbs and Forste 2014a, 2014b). Birthweight was measured by three dummy variables: normal birth weight (above 5.5 pounds), low birth weight (5.5–3.3 pounds), and very low birth weight (below 3.3 pounds). Race and ethnicity of the child was reported by the parent and measured by four dummy variables: non-Hispanic White, non-Hispanic Black, Hispanic (any race), Asian, and other racial groups. We also accounted for whether or not the child was a twin (1 = yes, 0 = no) and gestation age measured in weeks based on data from the birth certificate. Child's sex was coded 1 = female and 0 = male.

Mother Characteristics

Because characteristics of the mother might influence both attachment and breastfeeding behavior (Jackson 2016), we controlled for maternal age at birth measured in years, whether or not the mother was born in the U.S. (1 = yes, 0 = no), and maternal BMI based on self-reported height/weight measures. We also controlled for whether or not the mother smoked during the last 3 months of pregnancy (1 = yes, 0 = no), as well as for maternal depression. The depression measure was constructed from questions using an abbreviated form of the Center for Epidemiologic Studies Depression Scale (CES-D). This abbreviated measure of the CES-D compiled various questions about how the mother reported feeling the past week. As reported by NCES, the Cronbach's alpha for the factor was 0.9 (Nord et al. 2006).

Results

We report descriptive statistics in Table 1. Results are reported for both weighted and unweighted means. The rate of predominant breastfeeding, for example, is 17% in the United States for children born in 2001, yet the sample percentage is 11% due to oversampling of disadvantaged households. Predominant breastfeeding for under four months in the most common at 71% of the U.S. population. See Table 1 for other sample characteristics.

Table 2 reports the correlation between measures of infant attachment security and temperamental dependency. As reported elsewhere (Roisman and Fraley 2008), infant attachment security and temperamental dependency are not

Table 2 Correlation matrix of attachment measures and submeasures, ECLS-B 2001 (n = 8900)

		1	2	3	4	5	6	7	8	9	10	11
1	Infant attachment security	1.000										
2	Temperamental dependency	−.306	1.000									
3	Warm and cuddly	.748	.203	1.000								
4	Cooperative	.830	−.167	.725	1.000							
5	Enjoys company	.668	−.655	.275	.406	1.000						
6	Independent	.316	−.891	−.255	.025	.550	1.000					
7	Attention seeker	−.168	.869	.154	−.252	−.464	−.615	1.000				
8	Upset by seperation	−.308	.914	.046	−.282	−.636	−.700	.855	1.000			
9	Avoids others	−.183	−.187	−.424	−.299	−.403	.368	−.069	.021	1.000		
10	Demanding/angry	−.603	.673	−.415	−.657	−.640	−.422	.700	.715	.233	1.000	
11	Moody/unusual	−.853	.040	−.589	−.550	−.399	−.255	−.209	−.066	−.113	.154	1.000

Unweighted correlations

strongly correlated, suggesting they capture different constructs of attachment. Of the subitems, various measures are more strongly associated with the TAS-45 constructs of infant attachment security and temperamental dependency. "Warm and Cuddly" is most closely correlated with infant attachment security at .748 whereas "Upset by Separation" is most closely correlated with temperamental dependency at .914.

To gauge how parenting may be a proxy for breastfeeding behavior, we report the mean scores across our parenting measures in the analyses (see Table 3). As expected, we find that mothers who predominantly breastfed also have the highest scores for frequency of reading (wave 1 and wave 2), cognitive stimulation, maternal sensitivity, and maternal warmth. They also have higher socioeconomic status, education with the lowest rate of children attending daycare. Sibling size is slightly smaller than the sample and breastfeeding mothers are more likely to live with their biological partner in the home.

Tables 4 and 5 examine whether breastfeeding is associated with a child's attachment security and temperamental dependency at 2 years of age. In Table 4, Model 1, children predominantly breastfed six or more months score .09 higher on infant attachment security than children relative to those not predominantly breastfed ($p < .001$). This translates to a modest increase of about a 1/4 of a standard deviation (.09/.36 = .25). In Model 2, we add parenting measures, other infant feeding practices, and household, child and maternal characteristics and the association is reduced by 1/3rd (.03/.09 = .33). Thus,

Table 3 Descriptive statistics by weighted and sample means, ECLS-B, 2001

	Full sample (n = 8900)		Brestfed < 3 months (n = 6550)		Predominantly breastfed 3–5 months (n = 1000)		Predominantly breastfed 6 + months (n = 1350)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Parenting measures								
Frequency of reading (wave 1)	2.70	1.03	2.61	1.02	2.92	0.98	3.02	1.01
Frequency of reading (wave 2)	3.12	0.90	3.03	0.91	3.33	0.84	3.41	0.82
Cognitive stimulation (wave 2)	4.04	1.07	3.96	1.04	4.28	1.07	4.31	1.13
Maternal sensitivity (wave 2)	4.70	0.94	4.61	0.94	4.91	0.87	4.99	0.92
Maternal warmth (wave 2)	0.00	0.85	−0.02	0.87	0.07	0.72	0.04	0.81
Household characteristics								
Socioeconomic status	−0.03	0.86	−0.16	0.83	0.25	0.84	0.41	0.82
Mother's education level	4.33	1.96	4.06	1.88	4.96	1.98	5.17	1.96
Daycare	0.09	0.29	0.09	0.29	0.11	0.31	0.06	0.23
Sibling size	1.09	1.14	1.10	1.14	1.05	1.13	1.08	1.17
Both biological parents in home	0.84	0.74	0.83	0.84	0.86	0.34	0.93	0.26

Unweighted means. Data are imputed for missing values

Table 4 OLS Regression modeling the relationship between predominatly breastfeeding and other factors on infant attachment security at 2 years of age, ECLS-B, 2001 (n = 8900)

	Model 1			Model 2		
	b	(95% CI)	p value	b	(95% CI)	p value
Predominantly breastfed 6 + months	0.09	(0.06–0.12)	.000	0.03	(0.01–0.06)	.021
Predominantly breastfed 3–5 months	0.05	(0.02–0.09)	.006	0.01	(−0.03 to 0.04)	.667
Frequency of reading (wave 1)				0.00	(−0.02 to 0.01)	.570
Frequency of reading (wave 2)				0.04	(0.02–0.06)	.000
Cognitive stimulation (wave 2)				0.02	(0.00–0.03)	.021
Maternal sensitivity (wave 2)				0.03	(0.01–0.04)	.000
Maternal warmth (wave 2)				0.04	(0.02–0.05)	.000
Other factors		No			Yes	

Weighted means calculated using pweight = w2c0, psu = w2cpsu, strata = w2cstr. Data are imputed for missing values

Table 5 OLS regression modeling the relationship between predominatly breastfeeding and other factors on temperamental dependency at 2 years of age, ECLS-B, 2001 (n = 8900)

	Model 1			Model 2		
	b	(95% CI)	p value	b	(95% CI)	p value
Predominantly breastfed 6 + months	0.00	(−0.02 to 0.03)	.868	−0.01	(−0.04 to 0.02)	.511
Predominantly breastfed 3–5 months	0.00	(−0.03 to 0.03)	.991	0.00	(−.03 to 0.02)	.775
Frequency of reading (wave 1)				0.00	(−0.01 to 0.01)	.709
Frequency of reading (wave 2)				−0.01	(−0.02 to 0.00)	.141
Cognitive stimulation (wave 2)				0.00	(−0.01 to 0.01)	.899
Maternal sensitivity (wave 2)				−0.01	(−0.02 to 0.01)	.433
Maternal warmth (wave 2)				0.01	(0.00–0.03)	.085
Other factors		No			Yes	

Weighted means calculated using pweight = w2c0, psu = w2cpsu, strata = w2cstr. Data are imputed for missing values

predominantly breastfed children are score about 1/10th of a standard deviation higher than children predominantly breastfed for less than three months (.03/.36 = .08). It is noteworthy that other parenting behaviors from reading (b = 0.04, p < .001) to maternal warmth (b = 0.04, p < .001) have equally modest associations with infant attachment security. By comparison, breastfeeding and other parenting measures are not associated with temperamental dependency. No measure is statistically significant at .050 or less.

Finally, we explored the link between breastfeeding and a range of child attachment behaviors items. Children predominantly breastfed were rated as more "warm and cuddly," "cooperative," and are less likely to be considered "demanding and angry" compared with 2 year olds who were predominantly breastfed for less than 3 months. Not all measures revealed differences—"enjoying company," "independence," "attention seeking," "upset by separation," "avoids others" and "moody or unusual" behavior were all not statistically associated with predominantly breastfeeding for 6 or more months (Table 6).

Table 6 OLS regression modeling the relationship between predominatly breastfeeding (6 + or more) and child attachment behaviors at 2 years of age, ECLS-B, 2001 (n = 8900)

	b	(95% CI)	p value
Warm and cuddly	0.04	(0.01–0.07)	.002
Cooperative	0.04	(0.02–0.07)	.002
Enjoys company	0.03	(0.00–0.05)	.101
Independent	0.01	(−0.03 to 0.02)	.600
Attention seeker	0.02	(−0.04 to 0.01)	.164
Upset by seperation	0.01	(−0.03 to 0.01)	.268
Avoids others	0.02	(−0.05 to 0.00)	.104
Demanding/angry	0.05	(−0.06 to −0.02)	.001
Moody/unusual	0.01	(−0.06 to 0.03)	.629
Other factors		Yes	

Weighted means calculated using pweight = w2c0, psu = w2cpsu, strata = w2cstr. Data are imputed for missing values

Discussion

The relationship between breastfeeding and attachment security has been debated among researches and the

findings are mixed (Else-Quest et al. 2003; Britton et al. 2006; Kim et al. 2011). Our results reconcile by demonstrating that breastfeeding is associated with some of the measures of attachment security, but not all. Using longitudinal data and detailed measures of parenting behaviors related to cognitive development, we find that breastfeeding has a modest link to child attachment security. We also find that predominantly breastfed children (6 or more months) have higher scores for being "warm and cuddly" "cooperative" and lower scores for "demanding and angry" compared to children predominantly breastfed for less than 3 months. As these characteristics are part of a battery of measures of child attachment security, this suggests that not all aspects of a child's attachment security are linked to breastfeeding. We also show that breastfeeding does not appear to encourage or discourage clinginess, as measured by temperamental dependency.

There are several limitations to the data. Due to the data collection process, it is not possible to determine the exclusivity of breastfeeding as compared to formula feeding. Furthermore, the mother's I.Q. level was not available in the data, nor other biological markers beyond twin data (Roisman and Fraley 2008). These factors could have an unknown impact on the relationships observed in this study. Finally, our results, like most studies, are unable to confirm a causal relationship between breastfeeding and infant attachment security. Other factors that could account for the association between breastfeeding and infant attachment security beyond our analyses and the data collected.

Taken together, our findings suggest breastfeeding is modestly associated with infant attachment security, but not temperamental dependency. And although the mechanisms can not be clearly identified here, the benefits of breastfeeding for child attachment security appear net of parenting and other factors often associated with breastfeeding, further supporting claims that there may be socio-emotional benefits that extend beyond the nutritional properties of breast milk and other biological considerations (Shloim et al. 2016; Roisman and Fraley 2008; Kim et al. 2011; Jackson 2016).

One important implication of this study is that breastfeeding matters as a way to foster parent–child attachments in ways that could be replicated for mothers unable to breastfed. We find that breastfeeding increases the extent to which the child was observed as actively seeking and enjoying physical affection with the mother ("warm and cuddly") and increases the extent to which a child was observed as being more compliant and cooperative with parent requests and suggestions ("cooperative"). Conversely, breastfed children were slightly less likely to be quick to anger, tears, and or inconsolable after crying ("demanding/angry"). Can these child attachment behaviors be nurtured beyond the confines of breastfeeding? To the extent that breastfeeding is associated with greater maternal sensitivity because of feeding practices (Gibbs and Forste 2014a), such practices could be emulated during bottle-feeding and other parent–child interactions.

As the benefits of breastfeeding will undoubtedly be debated in the literature, we add a nationally representative assessment of its relationship to parent–child attachments, and with a wide array of confounding factors considered, find a modest, but enduring link.

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Compliance with Ethical Standards

Conflict of interest The authors have no conflict of interest to disclose.

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