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Highlights

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The evolved development niche: Longitudinal effects of caregiving practices on early childhood psychosocial development

Darcia Narvaez*, Tracy Gleason, Lijuan Wang, Jeff Brooks, Jennifer Burke Lefever, Ying Cheng

- Every animal has an evolved developmental niche for its young.
- Humans are not following their evolved developmental niche (EDN).
- The EDN for young children includes breastfeeding, positive touch, responsiveness, and social support (among other characteristics).
- We tested the influence on young children of these characteristics over time in a longitudinal dataset.
- Children's prosociality, behavior problems and cognitive development were examined.
- Results indicate that the EDN matters for child psychosocial and cognitive development.

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Early Childhood Research Quarterly

The evolved development niche: Longitudinal effects of caregiving practices on early childhood psychosocial development

Q1 Darcia Narvaez[a,*], Tracy Gleason[b], Lijuan Wang[a], Jeff Brooks[a], Jennifer Burke Lefever[a], Ying Cheng[a], the Centers for the Prevention of Child Neglect

[a] University of Notre Dame, United States
Q2 [b] Wellesley College, United States

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A B S T R A C T

Using an evolutionary developmental systems approach, we examined the effects of early care on children's psychosocial development. Our framework for early care is the set of parenting practices that emerged with the ~~catarrhine~~ mammals more than 30 million years ago, which were slightly altered in what we call the evolved developmental niche (EDN). Using an existing dataset of 682 families, we assessed four characteristics of EDN care—maternal responsivity, breastfeeding, touch, and maternal social support—and examined their effects longitudinally (prenatal to age 3) on children's prosociality (cooperation and social engagement), behavior problems (internalizing/externalizing), and cognitive ability (intelligence, auditory comprehension, and verbal expression) over three years. The EDN variables significantly and differentially affected child outcomes at different time points, even after controlling for maternal education, age, and income-to-needs ratio. Most significant findings were also retained when maternal responsivity was controlled. In summary, EDN-consistent behaviors in infancy provide necessary support for positive social and cognitive development in early childhood.

Child well-being in the USA is ranked at the bottom among economically-developed nations (Organization for Economic Co-operation and Development [OECD], 2009; United Nations Children's Fund [UNICEF], 2013; Woolf & Aron, 2013). The national prevalence of children under 5 with psychosocial problems has been on the increase to between 10% and 21% (Powell, Fixen, & Dunlop, 2003). The rates of *young* children whose behavior displays aggression, delinquency, or hyperactivity are on the increase, at times estimated to be as high as 25% (Raver & Knitze, 2002). The American Academy of Childhood and Adolescent Psychiatry reports a "crisis" in children's mental health–one in five children has a diagnosable psychiatric disorder, and one in every ten suffers from a mental illness severe enough to impair everyday living (American Academy of Child and Adolescent Psychiatry [AACAP], 2011).

The reasons for these declines in well-being early in life are undoubtedly nuanced and complex, but one piece of the puzzle worth investigating is the role of specific childrearing practices in fostering positive social and cognitive growth and development. As child well-being has dropped, so too have a host of specific parenting practices, such as natural childbirth and breastfeeding (Ball & Russell, 2013), that have likely been standard parenting behaviors for millennia. Consequently, we have taken up the recommendation for further examination of the relation between childrearing practices and child outcomes (Calkins, 2009) using ~~a~~ developmental systems theoretical approach (Oyama, Griffiths, & Gray, 2001), which broadens evolutionary inheritance beyond genes. We examine what has been called the human evolved developmental niche (EDN; Narvaez, Wang, et al., 2013). Each animal has an EDN for its young that matches parental care with offspring developmental maturation (Gottlieb, 1991). For social ~~(catarrhine)~~ mammals, who emerged over 30 million years ago, the EDN includes extensive breastfeeding, touch, prompt responsiveness, and play.

Over the course of human evolution, as infants were born increasingly early to accommodate bipedalism (i.e., pelvises shrank and babies had to be born before the head grew too large to pass the birth canal), parenting became correspondingly intensive (Trevathan, 2011). Anthropologists (Hewlett & Lamb, 2005) have recently drawn attention to the intensive childrearing practices that are standard among nomadic small-band groups, the social system in which the human genus spent over 90% of its existence (i.e., before agricultural settlement about 10,000 years ago). These rearing practices build on the ~~catarrhine~~ mammalian behaviors mentioned above, adding significant social support, alloparenting (caregiving by multiple adults) and greater variability in breastfeeding length (Hrdy, 2009; Konner, 2010). The practices fit into ~~the~~ evolved developmental niche (EDN) and are arguably an

* Corresponding author at: Department of Psychology, University of Notre Dame, Notre Dame, IN 46556, United States. Tel.: +1 574 631 7835; fax: +1 574 631 8883.
E-mail address: dnarvaez@nd.edu (D. Narvaez).

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integral part of the environmental context that supports human brain and body development through both physiological and psychological mechanisms (Hrdy, 2009; Konner, 2010). Indeed, these practices are noted for their effects on physiological health (Field, 1994; Hrdy, 2009; Porges, 2011).

The EDN framework was used in prior work (Narvaez, Wang, et al., 2013) to examine parenting effects on early moral development in a cross-sectional study. Each of the parenting practices, after controlling for maternal education and income, predicted one or more characteristics of moral development (e.g., empathy, conscience). In the current project, we had the opportunity to investigate the relation of several of these practices to child social and cognitive functioning over the first three years of life with an existing longitudinal data set. Specifically we were able to examine the practices of responsiveness, touch, breastfeeding, and maternal social support and their change over time on child prosociality, behavior problems, and cognitive ability. These three outcomes are important components of child psychosocial development (Farrant, Devine, Maybery, & Fletcher, 2012).

Theoretically, because of their presence throughout mammalian and then human evolutionary history, and co-evolving with the extreme immaturity of human neonates (Trevathan, 2011), EDN-consistent practices may provide contexts for the construction of brain/body systems that are fundamental to the development of positive child outcomes (Narvaez, Panksepp, Schore, & Gleason, 2013). Much like a set of vitamins that promote overall health in distinctive ways, EDN-consistent practices may provide the prerequisites for healthy psychosocial development. Well-functioning systems likely foster successful physiological and psychological self-regulation, an absence of problematic behaviors in social contexts, good communication, and mutually responsive dyadic relationships. However, little systematic study has examined how the presence of EDN-consistent or -inconsistent practices influence child psychological outcomes. Thus, we examined the influences of three parenting practices—responsivity, breastfeeding, and touch—that we postulate as central to the childrearing environment of the EDN. In addition, we examined maternal perceived social support as a proxy for the social embeddedness characteristic of the EDN as noted by anthropologists (Ingold, 1999). We explored whether these behaviors would differentially relate to three sets of child outcomes over three years: prosociality, behavioral problems, and cognitive ability.

Maternal responsivity has been identified not only in the anthropological literature as a likely standard practice throughout evolution, but also in the developmental literature as a significant predictor of children's social functioning (Kochanska, 2002; Landry, 1998; Parpal & Maccoby, 1985; Zimmer-Gembeck & Thomas, 2010). Indeed, attachment theory (Bowlby, 1969) is predicated on the assumption that particular behaviors designed to maximize contact between caregiver and infant co-evolved with the extensive needs of human offspring. If such caregiving is responsive and sensitive to the infants' needs, developmental outcomes are generally much more positive than if the care is neglectful—in both the physiological and psychological domains (Maunder & Hunter, 2008; Weinfield, Sroufe, Egeland, & Carlson, 2008). Likewise, breastfeeding and touch are associated with healthy physiological development (Narvaez, Panksepp, et al., 2013; Narvaez, Wang, et al., 2013), and may contribute to psychosocial development as well. By conceptualizing these variables and maternal social support as elements of a nurturing environment, and controlling for maternal responsivity, we hoped to highlight the differential impact of these parenting practices on children's psychosocial outcomes.

This work is timely for two reasons. First, some measures suggest that modern childrearing in societies such as the USA is increasingly divergent from EDN practices. For example, according to the US Surgeon General (Centers for Disease Control and Prevention [CDC], 2011), many mothers fail even to initiate breastfeeding. A second reason this research is timely is that although extensive literature in developmental psychology has documented the remarkable abilities of some children to survive overwhelming challenges (Masten & Wright, 2009), increasing alarms are being raised about early toxic stress (National Forum on Early Childhood Policy and Programs [NFECPP], 2010; Shonkoff & Phillips, 2000) and the complex interactions among caregiving, genetics, and sensitive periods (deBellis, 2010). Although most resiliency research has implicitly emphasized "good enough" childrearing (avoidance of negative outcomes), our goal is to apply an integrative perspective to the exploration of the early factors and interactions that maximize positive psychosocial outcomes (promotion of optimality). To do this we must examine the type of caregiving practices that evolved with our species.

1. Parenting behaviors consistent with the evolved developmental niche

1.1. Maternal responsive caregiving

From anthropologists' accounts of small-band hunter-gatherers in environments presumed to represent human genus history, mothers are highly and sensitively responsive to the needs of young children (Hewlett & Lamb, 2005; Hrdy, 2009). Preventing predation was certainly part of the evolved motivation to avert children's crying, but regardless, adults in these societies tend to be "indulgent" and quickly responsive to children's needs (Konner, 2005, 2010). The mechanism of responsivity, according to a mutual regulation model, is that both infant and mother represent a "larger dyadic regulatory system," each being a subsystem of the whole (Tronick, 2007, p. 9). Responsive caregiving means that the child is assisted in learning to coordinate communication and regulate arousal systems (Haley & Stansbury, 2003), including systems like the hormone oxytocin (important for social relations), leading to better stress regulation overall (Fleming, O'Day, & Kraemer, 1999; Heim & Nemeroff, 2001; Uvnas-Moberg, 1997).

A plethora of research connects maternal responsivity to positive child outcomes (Ainsworth, Bell, & Stayton, 1974). For example, maternal responsivity has been linked to attentional control in toddlerhood (Rodriguez et al., 2005), as well as to cognitive and language development (Landry, Smith, Miller-Loncar, & Swank, 1997). Preschool children with responsive mothers develop fewer behavior problems (Stein & Newcomb, 1994) and display greater self-regulation, empathy, early conscience development, and social competence (Kochanska, 2002; Parpal & Maccoby, 1985; Radke-Yarrow, Zahn-Waxler, & Chapman, 1983; Zahn-Waxler & Radke-Yarrow, 1990; Zimmer-Gembeck & Thomas, 2010), all of which are necessary for moral sensitivity and behavior. Likewise, maternal responsivity through the first few years of life is directly linked to children's social skills at 4.5 years, above and beyond concurrent and indirect effects (Steelman, 2002). Intervention studies (van den Boom, 1994, 1995) also demonstrate that enhancing maternal sensitive responsiveness is linked to infants' sociability, self-regulation, and exploration late in the first year, and to secure attachment, cooperation, and fewer behavioral problems in toddlerhood.

1.2. Breastfeeding

For our ancestors, breastfeeding was universal. According to anthropological reports, on demand breastfeeding among small-band hunter-gatherers typically continued for 2–5 years after birth, with an average weaning age of four (Hrdy, 2009; Konner, 2005). Breastfeeding has been linked directly to important aspects of psychological functioning, such as specific aspects of brain development and cognition. For example, breastfeeding has been positively related to executive function scores and social competence and negatively related to the incidence of ADHD in 4-year-olds (Julvez et al., 2007). Multiple studies have also associated breastfeeding with increased IQ and generally higher cognitive function in comparison to formula feeding, even when controlling for confounding variables such as maternal income and education (Anderson, Johnstone, & Remley, 1999; Michaelsen, Lauritzen, Jørgensen, & Mortensen, 2003; Mortensen, Michaelsen, Sanders, & Reinisch, 2002; Wigg et al., 1998). Even simple initiation of breastfeeding, separate from duration, has sometimes shown small but significant effects on measures of cognitive development (Jiang, Foster, & Gibson-Davis, 2011).

1.3. Touch

Touch is vital for human development (Field, 1994; Montagu, 1971). Anthropological and cross-species evidence (Hrdy, 2009) suggests that in the EDN, offspring were kept in close physical contact with others most of the time. Positive physical touch influences the development and wiring of physiological systems in mammals. For example, when monkeys are raised away from their mothers in the first months of life, their immune systems demonstrate a variety of deficits at least into middle childhood (Coe, Lubach, Ershler, & Klopp, 1989). Maternal touch over the long term facilitates appropriate responses to immune system challenges, such as vaccines, and the ability to produce antibodies (Laudenslager, Rasmussen, Berman, Suomi, & Berger, 1993). Meaney and colleagues have documented differences in gene expression within the brain-body pituitary-adrenal stress axis in rats, based on the extent of maternal touch soon after birth (Meaney, 2001; Weaver, Szyf, & Meaney, 2002).

In humans, touch fosters a secure attachment, which promotes social and cognitive functioning (Cushing & Kramer, 2005). In fact, maintenance of physical contact is a significant component of the way in which attachment is assessed in infancy (Ainsworth, Blehar, Waters, & Wall, 1978). Maternal carrying decreases crying in early life (Hunziker & Barr, 1986) and increases maternal responsivity (Anisfeld, Casper, Nozyce, & Cunningham, 1990). Similarly, the positive effects of massage on preterm infants' development and well-being have been well-documented (Field, 1995).

In contrast to positive touch, negative touch can be detrimental to developmental outcomes. Spanking in early childhood is associated with later aggression, even after controlling for confounding factors (Taylor, Manganello, Lee, & Rice, 2010). A linear relationship has also been established between being hit in childhood and lifetime prevalence of psychiatric disorders, including anxiety, alcohol abuse, and externalizing disorders (MacMillan et al., 1999). Hence, we expected that the combination of the *presence* of positive touch and the *absence* of negative touch would lead to better child outcomes.

1.4. Maternal social support

Small-band hunter–gatherer communities are tightly knit (with porous boundaries), living in close physical and social proximity (Fry, 2005). In these contexts, individual isolation was viewed as punishment—an unhealthy and potentially even risky option. Hrdy (2009) persuasively demonstrates the evolved need for social support to encourage maternal investment in offspring, emphasizing the high level of alloparenting characteristic of hunter–gatherer groups. In fact, the need for assistance in caring for the young is so great in humans and other species with high levels of cooperative breeding that mothers will abandon their infants when sufficient social support and alloparents are unavailable. Moreover, lack of support is associated with maternal stress, which generally interferes with nurturing maternal behaviors—thereby negatively influencing child outcomes (Garmezy, 1983). Indeed, mothers who report less affective and maternal assistance in their child-rearing roles have infants who demonstrate more insecure attachment styles in comparison to mothers with more assistance (Crockenberg, 1981).

The benefits of maternal social support for child outcomes extend well beyond infancy. Mothers' perceptions of social support have been positively related to children's social skills and negatively related to children's behavior problems (Achenbach, 1974; Koverola et al., 2005). For example, among kindergarteners, a mother's perceived social support was related to teacher ratings of children's competence in the classroom (Pianta & Ball, 1993). Longitudinal data from mother–child dyads also reveals that social support mediates the effect that maternal depressive symptoms have on children's externalizing behaviors at 8 years old (Koverola et al., 2005). Likewise, first-time mothers who were visited by nurses over two dozen times before and after birth until their children were age two had children who were less emotionally reactive, ahead in language learning, and higher in cognitive development in adolescence than controls (Olds, Henderson, Chamberlin, & Tatelbaum, 1986; Olds et al., 2002; Olds, Sadler, & Kitzman, 2007).

1.5. Current study

We conceptualized EDN-consistent care as an early environment whose components differentially promote positive development. We used an existing longitudinal data set and conducted novel hypotheses (Borkowski et al., 2012) on four EDN characteristics of interest. We were fortunate in that the dependent measures available to us encompassed child outcomes relevant to our interests in psychosocial development, including observations of prosociality (cooperation and social engagement), standardized measures of cognitive ability (intelligence, expressive communication, and auditory comprehension), and mothers' reports of behavior problems (internalizing and externalizing). Our analytic approach was to investigate the EDN-consistent variables available in this dataset in relation to these child outcomes across multiple time points, expecting that different patterns of relations would emerge for different characteristics of the early nurturing environment. For instance, we expected maternal responsivity to influence all outcomes, given its centrality to psychological functioning in the mother–child dyad (Bowlby, 1969; Tronick, 2007). We expected that breastfeeding initiation would be related to (lack of) child behavior problems and to cognitive development. The implications of touch for the management of stress (Weaver et al., 2002) and for the development of secure attachments (Cushing & Kramer, 2005) led us to expect positive relations between this variable and child prosociality (cooperation and social engagement) and negative relations with behavior problems. Lastly, the work on maternal social support (Burchinal, Follmer, & Bryant, 1996; Olds et al., 1986, 2002, 2007) suggests connections between maternal social support and children's prosociality and cognitive ability, and that of Achenbach (1974) and Koverola et al. (2005) suggested negative correlations between perceived social support and behavior problems.

The longitudinal nature of our data also allowed for an examination of the relations between the different parenting behaviors and the child outcomes over time. Based on findings showing that the mother–child relationship is established by 4 or 5 months (Beebe et al., 2010; Feldman, Greenbaum, & Yirmiya, 1999), we expected that the effects of maternal responsivity would be established early and that all child outcomes measured early and later would benefit from early responsivity. For example, sensitive

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and responsive care is associated with security of attachment. In turn, attachment security is linked to fewer behavior problems in preschool and avoidance of either bullying or victimization (Sroufe & Fleeson, 1986). We expected that breastfeeding would have lasting effects on behavior problems. Similarly, based on neurobiological reports of touch's importance for early self-regulation (Schanberg, 1995), we expected that those with more positive touch over time would demonstrate better self-regulation (fewer behavior problems). We expected that social support, because of its importance for maternal wellbeing and subsequent responsivity to her children would yield continuous positive effects on all child outcomes.

Lastly, we were interested in the effects of breastfeeding, touch, and maternal social support even after controlling for the influence of maternal responsivity. If, in fact, these variables do contribute in unique ways to the child outcomes studied, we expected that these aspects of EDN-consistent care would have long-term effects even after their shared variance with maternal responsivity was eliminated.

2. Method

2.1. Participants

Data were obtained from the Parenting for the First Time project (PFT; Borkowski et al., 2012; Lefever et al., 2008), a 3-year longitudinal (prenatal to age 3) study of mother–child dyads at risk for child neglect. First-time (primiparous) mothers and their children were recruited in their last trimester of pregnancy from primary care facilities and other agencies serving low-income mothers during 2002–2005 in four US cities: Birmingham, AL; South Bend, IN; Washington, DC; and Kansas City, KS/MO. At-risk mothers were recruited from clinics that served pregnant women in poverty as well as agencies such as Women, Infants and Children (WIC). All mothers were screened for age and education level. The total sample (N = 682) had 396 adolescent mothers (M_{age} = 17.5 years, SD = 1.12 years), 169 adults with limited education beyond a high school diploma (M_{age} = 25.5 years, SD = 3.0) and a comparison group of 117 adults with at least two years of college (M_{age} = 27.9 yrs., SD = 3.9). Overall, ethnicities were 65% African-American, 19% European-American, 15% Hispanic-American, and 1% other. At the prenatal interview, 61% were single, 16% married, and 22% living with a partner; 22% were employed and 49% worked until pregnancy.

2.2. Procedure

For the current project, a subset of the variables from the larger PFT data set were used, including data from interviews that took place during the mothers' last trimester of pregnancy and when their infants were 4, 6, 8, 12, 18, 24, 30, and 36 months old. The focus of the PFT study was on the transition to motherhood and the early experience of the child, so measurements were gathered more frequently in the first year. The interviews at 4, 8, 18, and 30 months were generally conducted in the home and included observations of mother–child interaction (Landry et al., 1997) and the home environment (HOME, Caldwell & Bradley, 1984, 2001). The visits typically included 1½–2 h of time observing the mother and child interact. The other interviews included a set of questions about family history, family structure, mother's perspectives on parenting, family activities, and sources of material and social support. At 24 and 36 months, individual standardized testing was conducted to assess the child's IQ and language and the mother was interviewed concerning the child's socioemotional development. Predictor variables used were maternal responsivity, touch, breastfeeding initiation and maternal reports of social support. Child outcome variables included observations of prosociality (i.e., cooperation, social engagement), cognitive ability (i.e., intelligence, auditory comprehension, verbal expression), and behavior problems (i.e., internalizing and externalizing). Maternal education group (see below) and family income-to-needs ratio were used as covariates in the analyses.

2.3. Measures

2.3.1. Family demographics

Information about maternal age, race, education level, household income, as well as number of household members supported by that income, was collected as part of a larger interview. Because of its importance as a covariate (Lamb, 1998; National Institute for Child Health and Human Development Early Child Care Research Network [ECCRN], 2001), a household income-to-needs ratio was calculated (estimated yearly total household income divided by the number of people supported by it). We used two dummy coded variables to code the three groups: teen vs. adult high-education mothers, and adult low-education mothers vs. adult high-education mothers.

2.3.2. Maternal responsivity and touch

The responsiveness of mothers as well as use of touch with their children was measured using select items from the Infant/Toddler (4, 8, and 18 months) and Early Childhood (30 months) versions of the Home Observation for the Measurement of the Environment (HOME; Caldwell & Bradley, 1984, 2001). The overall measure consists of a 45-item checklist completed from observations and parent-reports during a lengthy in-home interview. In order to more closely match our constructs of interest, we used only the Responsivity subscale from the HOME, which consists of 11 items that pertain to the mother's verbal and affective responsiveness to the child and verbal responsiveness to the interviewer. We also computed a new Touch scale as the sum total of the following items from the HOME observations (each coded as 0 vs. 1, higher scores being more positive): (1) no more than one instance of physical punishment, (2) does not slap or spank the child, (3) does not interfere or restrict the child more than twice, (4) parent picks up child regularly when not sleeping, and (5) parent caresses or kisses child at least once during visit. Although these include negative touch items (reversed scored), our other studies show the most variability on negative touch items. Cronbach's alphas were calculated for each time point for both scales in the current study (alphas for responsivity ranged from .69 to .78 and, for our proxy measure of touch, .34 to .45). Inter-rater reliability was established using video and subsequent live interviews until a criterion of 90% agreement was reached and fidelity was reassessed every 6 months throughout the course of the project.

2.3.3. Breastfeeding initiation

Breastfeeding initiation was asked as part of a larger structured interview when the infant was 6 months old ("What have you fed your baby in the first 6 months? Check all that apply.") Although breastfeeding duration was measured, it was collected retrospectively at 36 months and relatively few (n = 78) participants responded. Consequently, we used only breastfeeding initiation in this study.

2.3.4. Maternal social support

The Social Support Inventory (SSI) was created for PFT by modifying items from the My Family and Friends scale (MFF; Reid, Landesman, Treder, & Jaccard, 1989), which assesses maternal satisfaction (6-point Likert scale) with support (emotional, parenting, companionship) received from the participant's mother, the infant's father, the participant's best friend, and another support person named by the participant. Higher scores indicate higher perceived support. This measure had high internal consistency, with a Cronbach's alpha of .92. Social support was measured when the infants were 6 and 18 months.

2.3.5. Prosociality

To provide a direct assessment of mother–child interaction, home visitors conducted 20-minute naturalistic observations of mother–child pairs during the 18 and 30 month home visits. Mothers were instructed to do what they would normally do with the child and to pretend that the interviewer was not there. After a 2-minute warm-up period, the dyad was observed for four 5-minute observation intervals with time between intervals for rating both mother and child along several dimensions. Observational ratings were based on a coding schema developed by Landry et al. (1997). Our analyses focused on two child variables: cooperation (give and take with mother's requests, can be redirected to a new activity), and social engagement (engages mom with verbal and non-verbal communication, shared enjoyment). Each dimension of child behavior was rated on a 5-point scale, with higher scores indicating more positive behavior. These two variables were combined to form a latent construct "prosociality." Interviewers were trained to 80% reliability with a master coder during videotaped and in vivo observations (Hammond, Landry, Swank, & Smith, 1999), and fidelity was reevaluated every 6 months throughout data collection.

2.3.6. Cognitive ability

Child cognitive ability was measured at 24 and 36 months using the following measures: cognitive ability with the Mental Development Index of the Bayley Scales of Infant Development-II (BSID-II; Bayley, 1993); expressive communication and auditory comprehension with the Preschool Language Scale-4 (PLS-4; Zimmerman, Steiner, & Pond, 2002). These three variables were combined to form a latent construct "cognitive ability." Prior research has reported coefficient alphas ranging from .78 to .92, for the BSID-II, with a test-retest reliability of .83 (Bayley, 1993). In the current sample, internal consistency coefficients ranged from .74 (36-months) to .85 (24-months). For the PLS-4, reported internal consistency coefficients ranged from .72 to .97 for 1- to 5-year-olds with a test-retest reliability ranging from .82 to .97 (Zimmerman et al., 2002). In the current sample the internal consistency coefficients were .73 (24-months) and .78 (36-months) for auditory comprehension and .78 (24-months) and .76 (36-months) for expressive communication.

2.3.7. Behavior problems

Children's behavior problems at 24 and 36 months were assessed using the maternal-report measure, the Infant-Toddler Social and Emotional Assessment (ITSEA; Carter & Briggs-Gowan, 2006; Carter, Briggs-Gowan, Jones, & Little, 2003), for two domains of behavior: externalizing and internalizing (reported alphas were .87 and .80, respectively). A total of 91 items were rated on a 3-point scale (*not true/rarely* to *very true/often*). Cronbach's alphas for the current study were .87 for externalizing, and .81 for internalizing. The two variables were combined to form a latent construct "behavior problems." For all three latent constructs (prosociality, cognitive ability, and behavior problems), the measurement models had good fit based on criteria established by Hu and Bentler (1999). For example, CFI $\geq$ .95 and RMSEA $\leq$ .06. We also used an absolute fit index: the chi-square test. A non-significant test result indicates good model fit.

3. Results

3.1. Plan of analyses

In order to assess the relation of EDN characteristics on child outcomes across time, we used structural equation modeling (SEM) implemented in EQS 6.1 (Bentler, 2006). We examined the impact of each EDN variable (maternal responsivity, touch, breastfeeding initiation, and maternal social support) on each latent child outcome (prosociality, cognitive ability, and behavior problems) separately, controlling for two demographic covariates: income-needs ratio and mother's age/education group (teen, low-education adult, high-education adult). Two dummy-coded variables were created for mother's age/education group to create orthogonal contrasts among the three groups. Each child outcome was assessed twice with the child outcome measured at the first time point predicted by EDN practices, and the child outcome measured at the second time point predicted by EDN practices while controlling for the child outcome measured at the first time point. In addition, because maternal responsivity has been a longstanding factor in predicting child outcomes (Landry, Smith, & Swank, 2006), in a second set of analyses we controlled for maternal responsivity (in addition to the two background covariates) for EDN variables that were significantly related to child outcomes, as we were interested in determining whether significance remained even after statistically controlling for responsivity.

We used multiple strategies to address the challenges of working with multivariate longitudinal data. First, across all models, we applied full information maximum likelihood estimation (FIML) to handle missing data (see sample size information in Table 1) assuming that the missing data mechanism was Missing at Random (MAR). Consequently, as FIML uses all available data information, the sample sizes reported in the results are sometimes greater than the sample sizes listed in Table 1. Second, as is the case with most multivariate psychological data sets, the large majority of our manifest variables did not resemble a normal distribution (high kurtosis). In order to deal with this issue, we used robust methods that work with non-normal missing data (Yuan & Bentler, 2000), which down-weights the influence of outliers and allows for robust estimation and inference when normal distribution assumptions are violated.

Table 1 displays the time points at which data on each variable were collected along with descriptive statistics for all EDN variables and child outcomes for the entire sample. Table 2 shows the data by group. In general, the adult high-education group receives on average more social support, and is more consistent (less variability) in EDN practices than the other two groups. On the child outcomes, the high-education ~~mothers~~ had higher scores on good outcomes, lower scores on negative outcomes, and less variability. To determine if and how EDN variables were related, and how they related to child outcomes over time, we ran correlational analyses (Tables 3 and 4). The AHHM variables were weakly or moderately related to one another.

3.2. Relation of individual EDN variables to child outcomes

Table 5 summarizes the significant results for each EDN variable on child outcomes, including unstandardized coefficients and fit indices, when controlling for background covariates. Table 6 then summarizes whether these results remain significant when further controlling for maternal responsivity. All reported SEM models demonstrated adequate and good fit to the data. We summarize the results below.

Table 1
Descriptive statistics of EDN variables and child outcomes for whole sample.

Variable	Month	Mean (*SD*)	*N*	Range
Income/needs ratio[a]	6	3.62 (.46)[a]	311	2.55–5[b]
EDN variable				
Maternal responsivity	4	8.27 (1.76)	468	1–10
Maternal responsivity	8	8.38 (1.71)	406	2–10
Maternal responsivity	18	8.71 (1.57)	392	2–10
Maternal responsivity	30	8.69 (1.74)	358	1–10
Percent (%) breastfed		41.6%	531	0–1
Touch	4	4.58 (.71)	466	1–5
Touch	8	4.20 (.97)	405	0–5
Touch	18	3.62 (1.16)	390	0–5
Touch	30	3.46 (1.24)	359	0–5
Maternal social support	6	82.43 (33.05)	404	6–144
Maternal social support	18	80.89 (30.56)	408	6–144
Child outcomes				
Prosociality				
Cooperation	18	4.11 (.84)	363	1.25–5
Cooperation	30	4.29 (.86)	341	1–5
Social engagement	18	3.62 (1.02)	368	1–5
Social engagement	30	3.63 (1.23)	341	1–5
Behavior problems				
Externalizing problems	24	.70 (.32)	415	.04–1.67
Externalizing problems	36	.61 (.84)	363	.00–1.54
Internalizing problems	24	.63 (.23)	412	.04–1.76
Internalizing problems	36	.58 (.25)	360	.00–1.55
Cognitive ability				
Intelligence	24	127.94 (9.26)	351	75–148
Intelligence	36	151.50 (7.72)	324	108–174
Auditory comprehension	24	25.77 (4.15)	332	10–41
Auditory comprehension	36	36.54 (5.60)	314	18–52
Expressive communication	24	28.59 (4.53)	348	9–47
Expressive communication	36	39.53 (5.22)	330	19–60

[a] Subgroup mean substitutes are used for imputing missing data.
[b] Log 10 transformation of original data.

Table 2
Means and standard deviations of EDN components and child outcomes by maternal group.

	Month	Teen *N* = 396	Adult low-ed *N* = 169	Adult high-ed *N* = 117
Income/needs ratio[a,b,c]	6	.53 (.05)[d]	.55 (.05)[d]	.60 (.04)[d]
EDN component				
Maternal responsivity[a,b]	4	7.96 (1.83)	8.59 (1.44)	9.13 (.98)
Maternal responsivity[a,b]	8	7.96 (1.86)	8.95 (1.15)	9.05 (1.21)
Maternal responsivity[a,b]	18	8.34 (1.71)	9.04 (1.37)	9.42 (.95)
Maternal responsivity[a,b]	30	8.29 (2.03)	8.90 (1.33)	9.47 (.82)
Percent (%) breast-fed[b,c]		30.5%	41.5%	77.1%
Positive touch[b,c]	4	4.54 (.76)	4.51 (.71)	4.80 (.52)
Positive touch[a,b]	8	4.03 (1.03)	4.36 (.88)	4.49 (.77)
Positive touch[b]	30	3.21 (1.22)	3.57 (1.27)	3.99 (1.03)
Maternal social support[b,c]	6	74.88 (31.60)	84.01 (33.57)	99.79 (29.46)
Maternal social support[b,c]	18	76.06 (28.74)	79.70 (30.89)	96.30 (30.65)
Child outcomes				
Behavioral regulation	18	4.44 (.65)	4.47 (.72)	4.60 (.54)
Behavioral regulation[b]	30	4.53 (.62)	4.66 (.57)	4.79 (.33)
Cooperation[a,b]	18	3.96 (.84)	4.24 (.87)	4.38 (.76)
Cooperation[a,b]	30	4.08 (.97)	4.43 (.75)	4.65 (.46)
Social engagement[b]	18	3.50 (1.04)	3.66 (1.00)	3.99 (.92)
Social engagement[b,c]	30	3.43 (1.30)	3.66 (1.20)	4.14 (.96)
Externalizing problems[b,c]	24	.74 (.31)	.73 (.32)	.54 (.29)
Externalizing problems[b,c]	36	.63 (.33)	.68 (.29)	.47 (.26)
Internalizing problems	24	.65 (.24)	.63 (.24)	.58 (.22)
Internalizing problems	36	.58 (.27)	.62 (.24)	.52 (.22)
Competence[b,c]	24	1.28 (.27)	1.33 (.27)	1.41 (.23)
Competence[b,c]	36	1.33 (.32)	1.37 (.28)	1.55 (.20)
Intelligence[b,c]	24	127.72 (8.52)	125.36 (10.24)	132.06 (8.63)
Intelligence[b,c]	36	150.28 (7.27)	150.70 (8.55)	156.47 (5.95)
Auditory comprehension[b,c]	24	25.43 (3.87)	25.35 (4.04)	27.39 (4.78)
Auditory comprehension[b,c]	36	36.46 (5.20)	35.86 (5.66)	40.78 (4.77)
Expressive communication[b,c]	24	27.88 (4.27)	28.38 (4.38)	30.97 (4.74)
Expressive communication[b,c]	36	38.61 (4.56)	38.62 (5.40)	43.43 (5.06)

Note. Numbers under maternal groups are means with standard deviations in parentheses. Multiple group comparisons with Bonferroni corrections; alpha = .05.
[a] Teens were significantly different from adults with low education.
[b] Teens were significantly different than adults with high education.
[c] Adults with low education were significantly different from adults with high education.
[d] Log 10 transformation of original data.

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Table 3
Correlations among EDN variables.

Variable	1	2	3	4	5	6	7	8	9	10	11
1. Maternal responsivity 4 months	–										
2. Maternal responsivity 8 months	.55	–									
3. Maternal responsivity 18 months	.48	.51	–								
4. Maternal responsivity 30 months	.53	.53	.61	–							
5. Breastfeeding (0 = no, 1 = yes)	.16	.25	.24	.19	–						
6. Touch 4 months	.22	.15	.12	.09	.07	–					
7. Touch 8 months	.14	.31	.23	.23	.20	.29	–				
8. Touch 18 months	.10	.11	.26	.13	.14	.15	.39	–			
9. Touch 30 months	.23	.32	.39	.46	.15	.13	.25	.37	–		
10. Maternal social support 6 months	.16	.20	.21	.19	.22	.11	.12	.10	.15	–	
11. Maternal social support 18 months	.12	.18	.13	.09	.12	.09	.00	.04	.13	.44	–

Note. *N*'s for each correlation vary between each pair of variables owing to missing data. All values equal to or greater than .11 are significant at the $p < .05$ level.

3.2.1. *Maternal responsivity*

Longitudinal trajectories revealed that maternal responsivity gradually increased over time starting at 4 months, reaching a peak at 18 months before dropping slightly at 30 months. We thus fit a latent-growth curve model for maternal responsivity, consisting of correlated intercept (maternal responsivity at 4 months) and change factors (change in maternal responsivity between 4 and 30 months), which resulted in a good fit (Hu & Bentler, 1999), $\chi^2(4, N = 583) = .91, p = .92$, CFI = 1.00, RMSEA = .000. Then we fit SEM models to study the impact of maternal responsivity on our latent child outcome variables controlling for our two background covariates. See Fig. 1 for a sample path diagram.

As expected, maternal responsivity related to all child outcome variables for at least one time point, if not both, when controlling for the two background covariates (see Table 5 for coefficients and fit indices). Specifically, maternal responsivity at 4 months predicted children's prosociality at both time points; change in maternal responsivity over time predicted children's prosociality at 30 months. Maternal responsivity at 4 months was also negatively related to children's behavior problems at both 24 and 36 months, but the change in responsivity was not, indicating that early responsivity may be especially important with respect to its influence on behavioral issues. Maternal responsivity at 4 months was positively related to children's cognitive ability at 24 months but not significantly related to children's cognitive ability at 36 months. However, change in responsivity over time predicted children's cognitive ability at 36 months.

3.2.2. *Breastfeeding initiation*

Of the 531 mothers who reported their choice, 41.6% initially breastfed their children. In order to assess the relation of breastfeeding initiation to child outcomes, we first controlled for the two background covariates (see Fig. 2 for a sample path diagram) and then determined whether any significant results remained when controlling for responsivity.

As expected, breastfeeding initiation was positively related to prosociality at 18 months and negatively related to behavior problems at 24 months (see Table 5 for coefficients and fit indices). Both of these results remained significant when controlling for responsivity (see Table 6). However, breastfeeding choice was not related to either variable at the second time point. Contrary to expectations, despite being positively correlated with all measures of cognitive ability, an SEM model relating breastfeeding to cognitive ability failed to reach convergence and thus the effect of breastfeeding initiation on cognitive ability was not assessed.

3.2.3. *Touch*

Observation of the longitudinal trajectories of touch from 4 to 30 months showed a systematic, linear change such that mothers demonstrated less touch as infants became toddlers. We were able to fit a latent growth model of touch that revealed good fit $\chi^2(1, N = 566) = .26, p = .61$, CFI = 1.00, RMSEA = .000. We then fit SEM models to assess the impact that touch at 4 months and latent change in touch between 4 months and 30 months had on different child outcomes with covariates (see Fig. 3 for a sample path diagram).

Table 4
Correlations between EDN variables and child outcomes.

Child Outcomes	EDN component									
	Responsivity				Touch				Social support	
	4 mo.	8 mo.	18 mo.	30 mo.	4 mo.	8 mo.	18 mo.	30 mo.	6 mo.	18 mo.
Cooperation 18 mo.	.11	.15*	.26**	.16**	.12*	.00	.08	.20**	.27**	.17**
Cooperation 30 mo.	.18**	.21**	.20**	.26**	–.08	.09	.02	.32**	.18**	.17**
Social engagement 18 mo.	.23**	.23**	.38**	.30**	.09	.16**	.16**	.27**	.21**	.14**
Social engagement 30 mo.	.19**	.21**	.20**	.38**	.08	.20**	.11	.35**	.14*	.06
Externalizing behaviors 24 mo.	–.08	–.18**	–.12*	–.18**	–.03	–.14*	–.17**	–.19**	–.25**	–.16**
Externalizing behaviors 36 mo.	–.08	–.13*	–.09	–.22**	–.10	–.13*	–.16**	–.24**	–.14*	–.13*
Internalizing behaviors 24 mo.	–.05	–.14*	–.14*	–.16**	–.02	–.05	–.02	–.09	–.11	–.11*
Internalizing behaviors 36 mo.	–.05	–.07	–.14*	–.15**	–.01	–.08	–.09	–.13*	–.01	.03
Intelligence 24 mo.	.13*	.10	.17**	.22**	.02	.02	.10	.14*	.06	.12*
Intelligence 36 mo.	.21**	.15*	.19**	.29**	.13*	.13*	.11	.25**	.10	.15*
Auditory comp. 24 mo.	.21**	.19**	.24**	.29**	.03	.06	.14*	.19**	.15*	.17**
Auditory comp. 36 mo.	.23**	.17**	.19**	.31**	.16*	.13*	.18**	.24**	.20**	.09
Expressive comm. 24 mo.	.19**	.19**	.24**	.29**	.03	.10	.08	.15*	.14*	.15**
Expressive comm.36 mo.	.21**	.16*	.16**	.30**	.11	.13*	.16*	.25**	.17**	.13*

Note. *Ns* vary. Comp.: comprehension; comm.: communication.
* $p < .05$.
** $p < .01$.

Table 5
Model results for all significant effects of EDN variables on child outcomes.

EDN component	Child outcome	Coefficients	Model fit
Maternal responsivity			
At 4 mo.	Prosociality 18 mo.	.44*	$\chi^2(26, N = 583) = 29.29$, $p = .30$
At 4 mo.	Prosociality 30 mo.	.21*	CFI = .963, RMSEA = .053
Change (4–30 mo.)	Prosociality 30 mo.	.40*	
At 4 mo.	Behavior problems 24 mo.	−.20*	$\chi^2(26, N = 583) = 17.51$, $p = .89$
At 4 mo.	Behavior problems 36 mo.	−.07*	CFI = .986, RMSEA = .035
Change (4–30 mo.)	Behavior problems 36 mo.	−.04	
At 4 mo.	Cognitive ability 24 mo.	.33*	$\chi^2(47, N = 583) = 44.55$, $p = .53$
At 4 mo.	Cognitive ability 36 mo.	−.04	CFI = .966, RMSEA = .049
Change (4–30 mo.)	Cognitive ability 36 mo.	.16*	
Breastfeeding (0 = no, 1 = yes)	Prosociality 18 mo.	.18*	$\chi^2(7, N = 556) = 2.75$, $p = .91$
	Prosociality 30 mo.	−.10	CFI = .999, RMSEA = .015
	Behavior problems 24 mo.	−.17*	$\chi^2(7, N = 549) = 2.28$, $p = .94$
	Behavior problems 36 mo.	.01	CFI = 1.00, RMSEA = .006
	Cognitive ability 24 mo.	–	Model did not converge.
	Cognitive ability 36 mo.	–	
Touch			
At 4 mo.	Prosociality 18 mo.	–	Model did not fit the data.
At 4 mo.	Prosociality 30 mo.	–	Coefficients not reported.
Change (4–30 mo.)	Prosociality 30 mo.	–	
At 4 mo.	Behavior problems 24 mo.	−.14*	$\chi^2(26, N = 583) = 30.58$, $p = .24$
At 4 mo.	Behavior problems 36 mo.	−.13*	CFI = .964, RMSEA = .049
Change (4–30 mo.)	Behavior problems 36 mo.	−.16*	
At 4 mo.	Cognitive ability 24 mo.	.09	$\chi^2(46, N = 583) = 55.85$, $p = .15$
At 4 mo.	Cognitive ability 36 mo.	.20*	CFI = .948, RMSEA = .057
Change (4–30 mo.)	Cognitive ability 36 mo.	.05	
Social support	Prosociality 18 mo.	.40*	$\chi^2(14, N = 559) = 12.33$, $p = .58$
	Prosociality 30 mo.	.10*	CFI = .989, RMSEA = .041
	Behavior problems 24 mo.	−.29*	$\chi^2(14, N = 559) = 11.59$, $p = .64$
	Behavior problems 36 mo.	.10	CFI = .992, RMSEA = .037
	Cognitive ability 24 mo.	.20*	$\chi^2(30, N = 559) = 28.24$, $p = .56$
	Cognitive ability 36 mo.	.03	CFI = .977, RMSEA = .045

Note. Coefficients are standardized. Results listed are controlling for covariates (income/needs ratio and mother's age/education group). Mo.: month.
* $p < .05$.

A few findings for touch were consistent with our hypotheses. As predicted, touch at 4 months was related to lower incidence of behavior problems at 24 and 36 months; latent change in touch over time also predicted lower levels of behavior problems at 36 months (see Table 5 for coefficients and fit indices). When controlling for responsivity, only the effect on behavior problems at 36 months remained significant (responsivity was not significantly related), suggesting the importance of touch at early life stages (see Table 6). Although we did not expect a relation between touch and cognitive ability, touch at 4 months did positively predict cognitive ability at 36 months, even when controlling for responsivity (see Tables 5 and 6 respectively for coefficients and fit indices). Finally, we were unable to fit a successful model relating touch to prosociality.

3.2.4. Maternal social support

We transformed the social support variables by deriving the log (base 10) of the original variables at both time points to correct for multivariate non-normality. Social support showed little systematic change between 6 and 18 months, suggesting that maternal social support was established early and stayed relatively stable over time for this sample. Consequently, we established a

Table 6
Model results for significant effects of EDN variables on child outcomes controlling for maternal responsivity.

EDN component	Child outcome	Coefficients	Model fit
Breastfeeding (0 = no, 1 = yes)	Prosociality 18 mo.	.10*	$\chi^2(20, N = 583) = 26.84$, $p = .14$ CFI = .963, RMSEA = .059
	Behavior problems 24 mo.	−.15*	$\chi^2(20, N = 583) = 14.59$, $p = .80$ CFI = .983, RMSEA = .039
Touch			
At 4 mo.	Behavior problems 24 mo.	−.03ns	$\chi^2(59, N = 583) = 79.52$, $p = .04$
At 4 mo.	Behavior problems 36 mo.	−.17*	CFI = .933, RMSEA = .057
Change (4–30 mo.)	Behavior problems 36 mo.	−.03ns	
At 4 mo.	Cognitive ability 24 mo.	−.11*	$\chi^2(87, N = 583) = 109.24$, $p = .06$
At 4 mo.	Cognitive ability 36 mo.	.23*	CFI = .933, RMSEA = .056
Change (4–30 mo.)	Cognitive ability 36 mo.	−.06ns	
Social support	Prosociality 18 mo.	.27*	$\chi^2(41, N = 583) = 59.05$, $p = .03$
	Prosociality 30 mo.	.11*	CFI = .934, RMSEA = .062
	Behavior problems 24 mo.	−.24*	$\chi^2(29, N = 583) = 20.80$, $p = .87$ CFI = .980, RMSEA = .037
	Cognitive ability 24 mo.	.15*	$\chi^2(39, N = 583) = 33.10$, $p = .74$ CFI = .976, RMSEA = .040

Note. Coefficients are standardized. Results listed are controlling for demographic covariates (income/needs ratio and mother's age/education group). Mo.: month; ns: not significant.
* $p < .05$.

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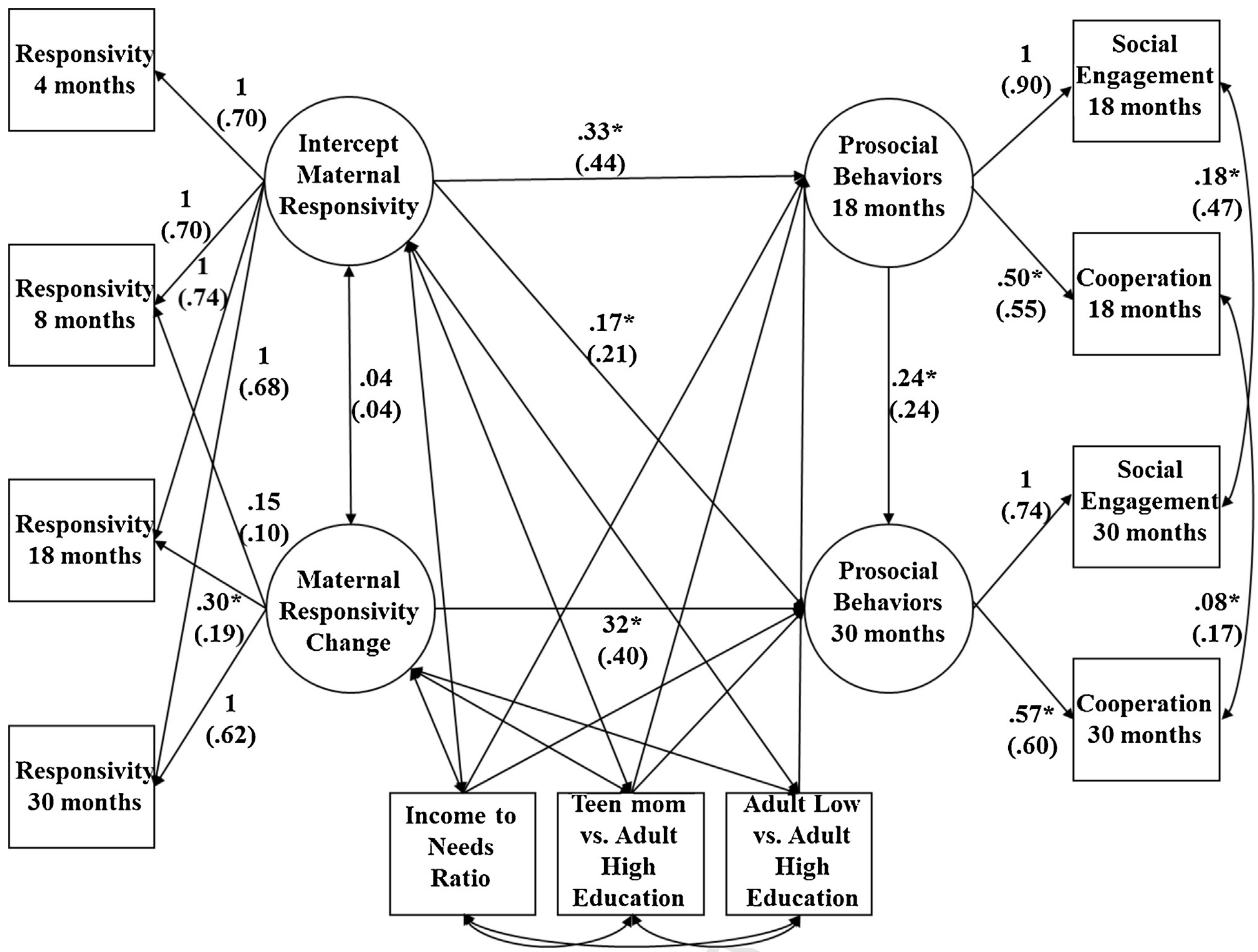

Fig. 1. Sample structural equation model demonstrating the influence of maternal responsivity on social engagement. Coefficients are unstandardized (and standardized). *$p<.05$.

no-change measurement model, $\chi^2(1, N=583)=.80$, $p=.37$, CFI = .997, RMSEA = .019. Then we fit SEM models to study the impact of social support on different child outcomes with demographic covariates (see Fig. 4 for a sample path diagram). From the SEM models, we found that when controlling for demographic covariates, our hypothesis that maternal social support would predict children's prosociality at both time points was supported (see Table 5 for coefficients and fit indices). Both of these relationships remained significant when controlling for responsivity (see Table 6). Maternal social support was also related to fewer behavior problems at 24 months and higher cognitive ability at 24 months, even when controlling for responsivity (see Tables 5 and 6). It was unrelated to either of these outcomes at 36 months, however.

4. Discussion

The findings presented here suggest that parenting practices consistent with the evolved developmental niche (EDN) are related to children's psychosocial and cognitive development. Our framework for considering the relation between EDN-consistent care and child outcomes included three expectations. First, we anticipated that each parenting variable would have differential effects on the set of child outcomes we studied. In general, we hypothesized that EDN-consistent care would be positively related to positive child outcomes and negatively related to problem behaviors in children, but we did not expect the patterns to be the same for each predictor. Second, we expected to find evidence that effects of maternal responsivity would emerge early in life, since much of the extant research focuses on outcomes evident in infancy (Tronick, 2007), and we explored changes over time between the other parenting variables and the child outcomes. Third, we predicted that EDN-consistent care would have long-term effects even after controlling for maternal responsivity. Overall, we found reasonable support for the first two of these expectations and modest support for the third.

EDN-consistent care was conceptualized in terms of the unique contributions of aspects of an early nurturing environment. All child outcome variables were predicted by maternal behavior early in life. Along with prior findings on interventions (Lyons-Ruth & Easterbrooks, 2006), these findings lend support to the idea that mother–infant interventions are best started early in their life together. In particular, maternal responsivity and touch at 4 months predicted many later child outcomes, conforming to prior research (Beebe et al., 2010).

The significance of responsivity varied across the different domains of development. Early maternal responsivity and the generally positive changes in maternal responsivity over time were strongly associated with children's prosociality, providing further emphasis on the importance of this childrearing practice for sociomoral development. Responsivity also predicted lower behavior problems at both time points, but change in responsivity did not predict behavior problems at age three. One interpretation of these results is that increases in responsivity are not as critical to reducing the risk of behavior problems in preschool as a stable responsivity pattern established by 4 months. Interestingly, while responsivity

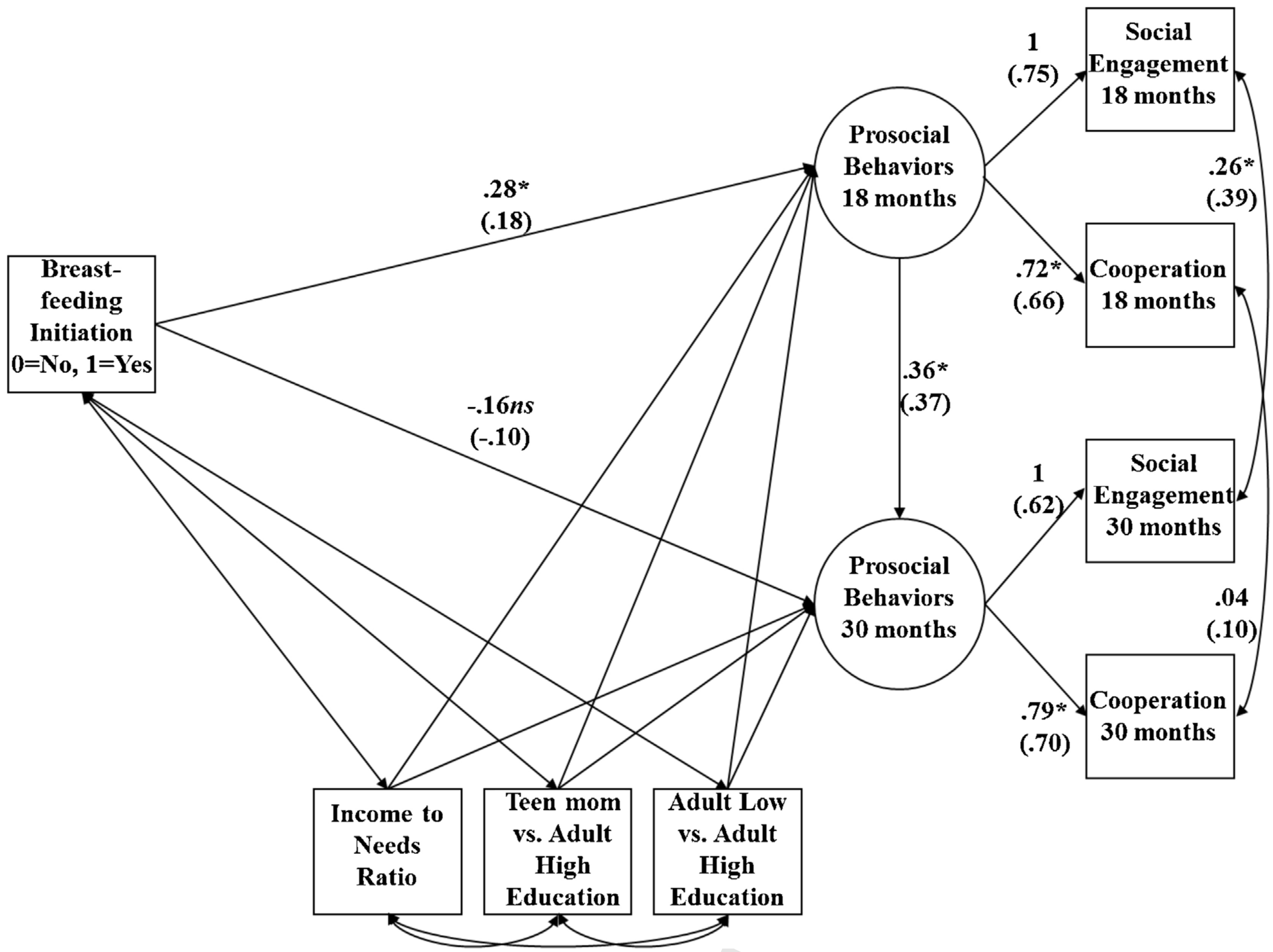

Fig. 2. Sample structural equation model demonstrating the influence of breastfeeding on social engagement. Coefficients are unstandardized (and standardized). $^{*}p < .05$.

at 4 months also predicted cognitive abilities, the effect was limited to age two years. The patterns of cognitive development established by age two might thus be more influential on later cognitive abilities than is early responsiveness. On the other hand, a greater increase in maternal responsivity was positively associated with cognitive ability at 36 months. This finding suggests that as the child becomes an ever more active participant in the mother–child relationship, a concomitant increase in maternal responsivity might boost cognitive development just at it seemed to for prosocial outcomes.

As expected and in line with previous research (Kochanska, 2002; Radke-Yarrow et al., 1983; Zimmer-Gembeck & Thomas, 2010), maternal responsivity was the most comprehensive predictor of child outcomes, and so we used it as a covariate. After controlling for maternal responsivity, many patterns for the other parenting practices remained significant. Overall, the strong connections between parenting practices and child outcomes controlling for responsivity emphasize the differential contributions these practices make to child development. Indeed, each of the EDN variables predicted multiple child outcomes above and beyond responsivity. These findings suggest that while sensitive, responsive parenting might go a long way toward promoting children's development, other EDN-consistent practices such as breastfeeding, touch, and social support could be similarly critical to facilitating prosociality and minimizing behavior problems.

In contrast to the other predictors, the effects of touch were restricted to later rather than earlier time points for both behavior problems and cognitive ability after controlling for maternal responsivity. For cognitive ability, this result may have been owing to the fact that our measures of cognition related to language development, which advances significantly between ages two and three. Consequently, the variation in cognitive ability as a function of early touch may not have been measurable at 24 months. The explanation for the delayed or time-lagged connection between early touch and behavior problems is unclear, but even so, these findings emphasize how the patterns of parenting behaviors within the first few months have significant implications for later functioning.

Although we were unable to account for outcomes due to the duration of breastfeeding for lack of data, the fact that the mere initiation of breastfeeding successfully predicted higher prosociality at 18 months and fewer behavior problems at 24 months emphasizes the importance of early parenting decisions and practices. Moreover, in our models controlling for outcomes at these first time points negated the relations of breastfeeding to the second time point—as was also true for the relations of social support to behavior problems and cognitive ability. The relation of the choice to initiate breastfeeding with prosocial developmental outcomes at 18 months was found; however, we could not verify the link between breastfeeding and cognitive ability (Oddy et al., 2003) since we were unable to fit a model that converged for these variables. Moreover, we had significant results from breastfeeding initiation even though the variable collapses across mothers who attempted to nurse once with those who nursed for months. In addition, initiation may be confounded with social support as findings for the two variables were similar.

Breastfeeding and social support both negatively predicted behavior problems at age two when responsivity was controlled.

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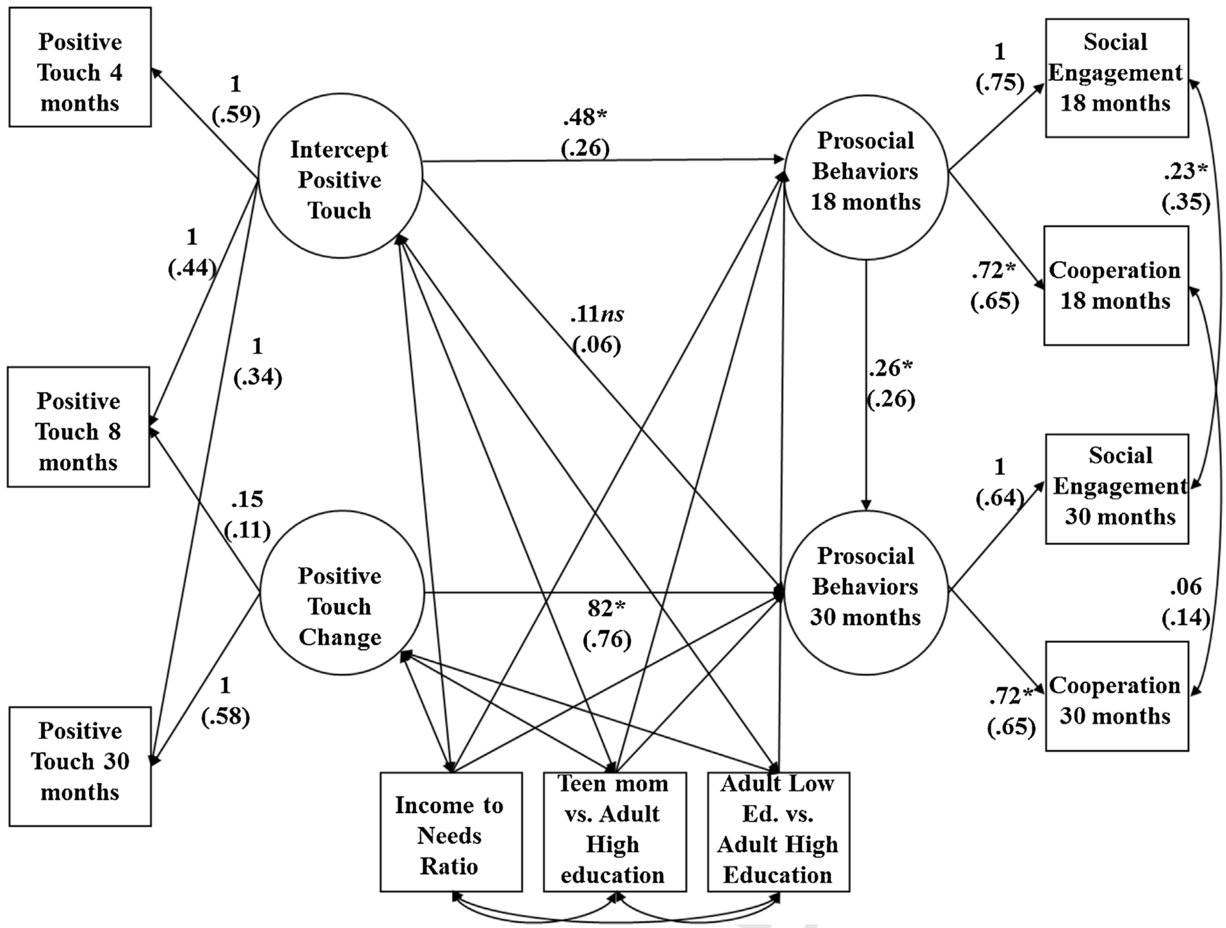

Fig. 3. Sample structural equation model demonstrating the influence of positive touch on cooperation. Coefficients are unstandardized (and standardized). $^*p < .05$.

These finding are corroborated by previous research with older children (Koverola et al., 2005; Robinson et al., 2008). The findings also converge with research demonstrating not only links between parents' perceived social support and reduction of negative parenting, but also children's prosociality (Ensor & Hughes, 2010), which was significant at both time points. Perhaps a feeling of social support is critical for helping parents ~~to~~ behave in ways that foster prosociality in their growing children, an idea supported by the fact that social support, but not breastfeeding, was related to prosociality at 30 months. Cognitive ability at 24 months was also predicted by social support, corroborating findings from other studies (Olds et al., 1986, 2002, 2007). Overall, social support may lead to primarily indirect effects, a finding that warrants further investigation.

The results of this study support two important conclusions. First, parenting consistent with that postulated as characteristic of the EDN showed distinctly positive relations to child development. The parenting behaviors were modestly correlated, and each had a differential pattern of relation to child outcomes, suggesting that child development may be supported by the *combined* presence of EDN variables even though this dataset measured just a few, at different timepoints, and in a proxy manner. Second, many, but not all, of the patterns of EDN-consistent parenting were established early, suggesting that as with most dynamic systems, both predictors and outcomes and their relations could change dynamically over time. This idea has already been demonstrated by interventions that provide maternal social support; they are more helpful for child outcomes the earlier they occur (Lyons-Ruth & Easterbrooks, 2006). For the few outcomes that showed greater impact later rather than earlier in development (e.g., touch on cognitive ability at age 3), future research could usefully address the physiological or psychological mechanisms that might suppress these effects in toddlerhood and/or promote them early in the preschool period.

4.1. *Implications for practitioners*

The findings have several implications for practitioners. Those who work with mothers (including expectant mothers) should be educated about the importance of early care for physical and mental health (Narvaez, Panksepp, et al., 2013). Practitioners need to know, and could educate parents, about the many positive associations between responding quickly and sensitively to an infants' signals, breastfeeding, touch, and social support and later social development. Support of mothers and infants in the perinatal period may be crucial for subsequent maternal responsivity and secure attachment. Practices like help with breastfeeding, explanation of the risks of *not* breastfeeding, and infant care through regular visits from nurses and lactation consultants, especially for first-time and at-risk mothers, may help parents be more responsive. Such programs, through emphasizing these maternal behaviors, might foster a greater likelihood of secure attachment and healthy development, even as far as behavior in preschool (Sroufe & Fleeson, 1986). The impact of early parenting practices suggested by our findings might even call for prenatal interventions. In fact, Honig and Moran (2001) reported that home visits with low-education teen moms that began prenatally were associated with a significant decrease in convictions for child abuse/neglect many years later compared with outcomes when home visits began after an infant was born.

Child care facilities could encourage and support working mothers to provide breastmilk for feedings during the work day. Pediatric

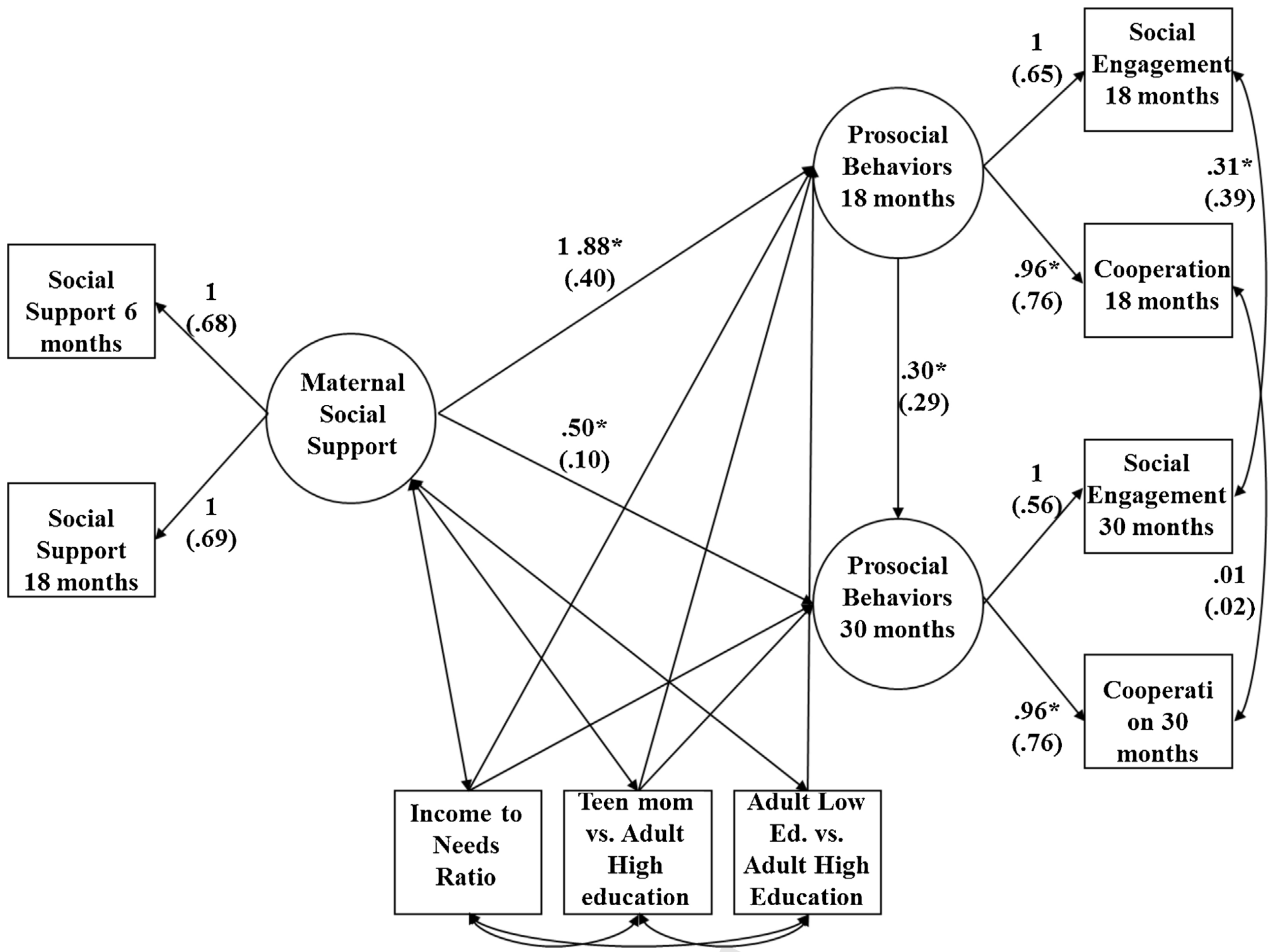

Fig. 4. Sample structural equation model demonstrating the influence of social support on cooperation. Coefficients are unstandardized (and standardized). $^{*}p < .05$.

providers should work with organizations such as La Leche League to do everything possible to encourage breastfeeding for at least a year, as recommended by the American Academy of Pediatrics, or more (two years are recommended by the World Health Organization).

Childcare workers can be encouraged to facilitate secure attachment with their charges through responsive, attentive glances and respectful attention to children's needs (Schore, 1994; Trevarthen & Aitken, 2001). Affectionate touch, which facilitates attachment to caregivers as well as healthy development, could be encouraged perhaps by baby-wearing, which increases responsivity and attachment (Anisfeld et al., 1990) or massage, which settles babies and improves health (Field, 1994). Additional suggestions for those who work in early care settings can be found in Honig (2002).

4.2. Limitations and future directions

The present analysis was limited by the use of an existing dataset conceptualized as a study of at-risk, rather than normative, parenting. The findings may differ for a sample more ethnically-representative of US children. The measures included were not designed to consistently capture each aspect of EDN parenting. For example, global perceived social support is a weak proxy for the social embeddedness characteristics of the EDN; the touch items do not represent the rich experience of touch in the ancestral environment that included near-constant carrying and cosleeping. Breastfeeding initiation is a variable that combines qualitatively different mothers—those that try once and give up and those that provide lengthy nursing, and thus it may be confounded with other maternal characteristics (e.g., responsivity).

To examine EDN-consistent characteristics more precisely, more focused measures should be developed and specific observational assessments made where possible. For example, breastfeeding data should include duration and be asked currently rather than retrospectively, reliable measures should be developed and validated to measure positive and negative touch separately, and the full complement of practices consistent with the EDN should be studied for their unique and combined patterns (e.g., co-sleeping, natural child birth). In addition, the inter-rater reliability of observed behaviors should be evaluated using a more stringent method, such as Cohen's κ (Ostrov & Hart, 2012). Percent agreement, as used in the current study, does not account for chance agreement and it can be biased when used with a small number of cases, as is typical when initially establishing reliability (Bakeman & Gottman, 1987). Although we were interested here in the unique relations of each parenting practice to the child outcomes, closer examination of the covariation between practices might provide valuable information on patterns of parental behavior and their associations with child outcomes, including whether mothers who are EDN-consistent on one variable tend to be consistent on other EDN variables. Moreover, more child outcomes should be examined, such as social variables like empathy and conscience.

Although we had a fairly diverse sample, these findings need to be confirmed in different societies, as cultural differences on the effects of various parenting practices have been documented. For example, Slade and Wissow (2004) found that greater

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spanking before age two was related to behavior problems in school for non-Hispanic white children but not for Latino or African-American children, suggesting that other factors of the early environment may mitigate or offset the experience of negative touch like spanking. Nevertheless, our expectation is that whereas the exact pattern of relationships between EDN-consistent characteristics and child outcomes might vary somewhat, the set of parenting behaviors that matter to positive child development, because of their basis in human evolutionary history, are likely to be similar across cultural and environmental contexts.

5. Conclusion

Our findings provide preliminary evidence that using an evolutionary developmental systems framework for examining parenting practices may be worthwhile. EDN-consistent parenting practices appear to provide a nurturing environment that facilitates development in multiple areas much like various nutrients from different sources influence different subsystems in the body. Each EDN-consistent practice may have a distinctive effect on child outcomes over time, yet all may be required for all-around positive physiological and psychosocial development. As parenting standards have slipped further from our ancestral heritage and trends for children's well-being continue to deteriorate (World Health Organization/World Organization of National Colleges, Academies and Academic Associations of General Practitioners/Family Physicians [WHO/WONCA], 2008; Woolf & Aron, 2013), it may be time to shift from a focus on "good enough" parenting environments to a focus on those that evolved to optimize the development of young children (Narvaez & Gleason, 2013; Narvaez, Panksepp, et al., 2013). Such a shift could open up new avenues for research and social policy for children and families.

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