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The Caregiving Environment and Developmental Outcomes of Preterm Infants: Diathesis Stress or Differential Susceptibility Effects?

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The interactions between premature birth and the caregiving environment on infants' cognitive and social functioning were examined. Participants were 150 infants (83 preterm, 67 full-term) and their parents. When infants were 6 months old, parents reported on their levels of emotional distress, and triadic family interactions were filmed and coded. At 12 months of age, the infants' cognitive and social functioning was assessed. Prematurity moderated the effects of maternal (but not paternal) emotional distress and triadic interactions on infants' cognitive and social outcomes. Whereas for cognitive functioning the interactions were consistent with a diathesis–stress approach, for social functioning the interactions were consistent with a differential susceptibility approach. The differential effects of the caregiving environment between groups and outcomes are discussed.

Preterm births (gestation < 37 weeks) account for 11% of all live births worldwide, ranging from 5% in some European countries, 12.8% in the United States, and up to 18% in some African countries (Blencowe et al., 2012). Accumulating evidence suggests that even under low medical-risk conditions, premature birth confers increased risk for poor cognitive and social outcomes throughout childhood (e.g., Brummelte, Grunau, Synnes, Whitfield, & Petrie-Thomas, 2011). Nevertheless, the risk associated with prematurity is not homogeneous and may depend on the presence of additional factors in children's early caregiving environments, which may enhance or alternatively reduce preterm infants' initial risk conditions (e.g., McManus & Poehlmann, 2012; Shah, Robbins, Coelho, & Poehlmann, 2013). Research has consistently demonstrated that early sensitive, responsive caregiving environments facilitate preterm infants' later cognitive and social development (Landry, Smith, Swank, Assel, & Vellet, 2001; McManus & Poehlmann, 2012; Shah et al., 2013). However, it is not known whether a supportive environment reduces the risk associated with prematurity by restoring normative development or, alternatively, possibly even by promoting functioning above the population-based norms. Furthermore, although previous research implied that preterm infants may be more affected by their caregiving environment than full-term infants (Landry, Smith, & Swank, 2006; Landry et al., 2001), this notion has yet to be tested systematically. This study aimed to address these issues by uncovering the nature of the interactions between infants' biological risk (preterm vs. full-term birth) and the early caregiving environment in predicting infants' early cognitive and social outcomes.

Cognitive and Social Development of Preterm Infants

There is substantial empirical evidence that even under low medical-risk conditions, infants born preterm score lower than full-term infants on standard cognitive assessments (e.g., Brummelte et al., 2011). For example, a recent study demonstrated that very low birth weight preterm infants with low medical risk exhibited lower cognitive functioning compared to full-term infants as early as 18 months of age (Brummelte et al., 2011) and that their cognitive level significantly declined from the age of 8 to 18 months, although no decline was evident among the full-term group (Brummelte et al., 2011). As for social development, infants born preterm tend to exhibit difficulties in early social communication

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skills such as social initiation and joint attention compared to children born full-term (De Schuymer, De Groote, Beyers, Striano, & Roeyers, 2011; Landry, 1986). Studies examining early joint attention capacities found that at the age of 6 months, preterm infants exhibited increased gaze aversion and moved their attention away during joint attention episodes more often than full-term infants when interacting with their mothers (Landry, 1986). Furthermore, they showed lower durations of gaze while following a target positioned within their visual field and less frequent initiations of behavioral request (De Schuymer et al., 2011). However, it seems that preterm infants with severe medical complications may be at the highest risk for developing difficulties in early social communication (De Groote, Roeyers, & Warreyn, 2006).

The Role of the Early Caregiving Environment in Preterm Infants' Development

The birth of a preterm infant is viewed as an emotionally traumatizing crisis, and parents of premature infants experience high levels of emotional distress (e.g., depression and anxiety symptoms) during the first few months after birth (Feeley, Gottlieb, & Zelkowitz, 2007). Maternal emotional distress has been linked to preterm infants' cognitive and social outcomes. For example, higher maternal depressive symptoms at 4 months of age directly predicted lower cognitive functioning at 16 months of age (McManus & Poehlmann, 2012). Furthermore, maternal emotional distress (e.g., high levels of anxiety and depression) has been negatively linked to children's cognitive development and internalizing behavior problems (Zelkowitz, Na, Wang, Bardin, & Papageorgiou, 2011). However, these findings are based solely on maternal emotional distress measures and do not refer to the possible role of paternal emotional distress in preterm infants' development. To the best of our knowledge, only one study reported that fathers' parenting stress and behavior predicted preterm children's communication and language skills at the preschool age (Magill-Evans & Harrison, 2001). Due to the growing body of evidence highlighting the importance of fathers' emotional distress in early cognitive and social development (e.g., Cabrera, Fagan, Wight, & Schadler, 2011; Gueron-Sela, Atzaba-Poria, Barak-Levy, Meiri, & Yerushalmi, 2011), we aim to expand the existing literature by examining the effects of both maternal and paternal emotional distress on children's developmental outcomes.

Over the past three decades, developmental psychology theory and research has recognized the importance of observing the wider family framework, beyond the mother–child dyad, in understanding children's development (McHale & Rasmussen, 1998). While participating in triadic interactions, children are repeatedly exposed to adult turn taking, cooperation, and competitiveness in relationships, which are essential components of socioemotional development (McHale & Rasmussen, 1998). Indeed, research has generally supported the link between the quality of family triadic interactions and children's social development (Feldman & Masalha, 2010; McHale & Rasmussen, 1998). For example, more cohesive (i.e., warm, involved, and harmonious family interactions) triadic interactions during infancy and toddlerhood predicted better social competence at the toddler stage (Feldman & Masalha, 2010). The study of the triadic family context following preterm birth has been relatively neglected. To the best of our knowledge, no studies have examined how the quality of triadic family interactions following a preterm birth affects children's cognitive and social development.

Vulnerability or Susceptibility to the Caregiving Environment Among Preterm Infants?

Traditionally, the dominant theoretical model for understanding relations between risk factors and adaptation was the diathesis–stress or dual-risk model (Monroe & Simons, 1991). This theoretical perspective suggests that poor environmental experiences (e.g., low-quality parenting) are most likely to negatively impact the development of individuals who carry vulnerability factors (e.g., difficult temperament) and less likely to affect nonvulnerable individuals. However, in the past decade, Belsky, Bakermans-Kranenburg, and van IJzendoorn (2007) proposed the differential susceptibility model, introducing a broader concept to the understanding of the interplay between risk factors and adaptation. According to this model some vulnerability or risk factors (e.g., difficult temperament, genetic disposition to difficult behavior) can be conceptualized as *plasticity* factors because they not only increase risk for negative outcome in the context of poor caregiving experiences (as in the diathesis–stress model), but also increase the probability of *positive* outcome under high-quality caregiving environments (Belsky et al., 2007). That is, the differential susceptibility model assumes that some individuals vary in their susceptibility to environ-

mental factors both "for worse" and "for better" (Belsky et al., 2007).

A growing body of evidence supporting the differential susceptibility hypothesis suggests that some children, due to behavioral (Belsky et al., 2007), biological (Obradovic, Bush, Stamperdahl, Adler, & Boyce, 2010), or genetic (Kochanska, Kim, Barry, & Philibert, 2011) characteristics, are more adversely affected by negative caregiving environments, but at the same time more positively affected by supportive caregiving environments. For example, infants high on negative emotionality were poorly self-regulated when they experienced unresponsive relationships with their mothers, but highly self-regulated when they experienced responsive mother–child relationships; however, for infants low on negative emotionality, there was no link between maternal responsiveness and infant self-regulation (Kim & Kochanska, 2012). In a study focusing on biological sensitivity to stress, children's high-stress reactivity (measured physiologically) was associated with more maladaptive social and school outcomes in the context of high family stress (e.g., financial stress, maternal depression), but with better adaption in the context of low stress (Obradovic et al., 2010).

Some evidence from previous research implies that preterm infants were found to be more strongly affected by their early caregiving environment in comparison to full-term infants (Landry et al., 2001, 2006). For example, full-term and preterm infants showed faster cognitive growth when their mothers were consistently responsive during the first 4 years of life; however, these links were stronger in the preterm group compared to the full-term group (Landry et al., 2001). Moreover, increased maternal responsiveness following an intervention program was linked to greater growth in infants' social and cognitive competence among full-term and preterm infants, but benefits were greater for the preterm group (Landry et al., 2006). Although, to the best of our knowledge, prematurity has yet to be tested as a potential "susceptibility factor," the neurological and behavioral profiles of preterm infants may be consistent with the documented susceptibility factors. A premature birth often results in brain functioning abnormalities, including white matter abnormalities such as changes in synaptic efficacy, loss of volume, enlarged ventricles, and alterations in myelination (Inder, Warfield, Wang, Huppi, & Volpe, 2005), which may result in difficulties in processing external stimuli and inappropriate adaption to stress. As a result, preterm infants may demonstrate less behavioral organization, as evident in less autonomic and motor modulation, lower attentional availability, and lower state regulation compared to full-term infants (Brown, Doyle, Bear, & Inder, 2006), and experience difficulties in emotional and behavioral regulation (Woodward, Clark, Pritchard, Anderson, & Inder, 2011). Preterm infants have also been generally described as being less adaptable and exhibiting more negative moods than full-term infants (Langkamp, Kim, & Pascoe, 1998). These low self-regulation capacities may make preterm infants highly dependent on external regulation provided by their caregivers. A supportive environment can successfully regulate physical and emotional arousal, enabling infants to actively explore and interact with their environments. However, a stressful unsupportive environment may not be able to effectively modulate infants' arousal, preventing exploration and social interaction. On the contrary, full-term infants possess more effective regulation capacities; thus, for them environmental support may be less detrimental.

The Present Study

The present study aimed to understand how infants' biological risk (preterm vs. full-term birth) moderates the links between the caregiving environment and infants' early cognitive and social outcomes. In an attempt to broaden the examination of the caregiving environment beyond the mother–child dyad, we focused on both maternal and paternal emotional distress levels and on triadic family interactions to predict children's outcomes. It was hypothesized that birth status group (i.e., preterm vs. full-term) would moderate the links between the early caregiving environment (i.e., parental emotional distress and triadic family interaction) and children's cognitive and social outcomes. Specifically, higher parental emotional distress would predict lower cognitive and social functioning, whereas positive triadic family interactions would predict higher functioning, and these links would be stronger among the preterm group than in the full-term group. Furthermore, we aimed to untangle the moderation effect of prematurity by examining whether preterm infants are affected only for "worse" (i.e., low functioning under heightened parental distress and low-quality triadic interaction) or also for "better" (i.e., outperforming their full-term counterparts under low parental distress and high-quality triadic interactions). In other words, are the interactions between prematurity and the

quality of the early caregiving environment more consistent with the diathesis–stress model or with the differential susceptibility model?

Method

Participants

Participants were full-term and preterm infants and their parents who were enrolled in the Preterm Early Development Study, a prospective, longitudinal study of preterm infants' early cognitive and social development. Infants and their families were recruited shortly after birth and followed up at ages 6 and 12 months (at both time points, age was corrected for prematurity for the preterm group). Families from the preterm group were recruited from the Neonatal Intensive Care Unit (NICU) and families from the full-term group were recruited from the maternity ward in the largest medical center in the southern region of Israel. The preterm group included singleton infants born between 28 and 33 weeks of gestation with low medical risk. Exclusion criteria included significant neonatal neurological complications and birth weight under 1,000 g. The full-term group included healthy singleton infants born after 37 weeks of gestation. Seventy percent of the parents, in each group, who were offered to take part in the study agreed to participate. The main reasons for refusal were time constraints and reluctance to be filmed. A total of 162 families (87 infants born preterm; 75 infants born at full-term) agreed to participate in the study after the infants' birth. At age 6 months, 150 families participated in the assessment (92.6% of the original sample). Three families could not participate due to medical reasons, 8 families refused to participate due to time constraints, and 2 families could not be traced. The preterm group included 83 infants (48 boys, 35 girls; M_{age} = 5.9 months, SD = 0.6) and the full-term group included 67 infants (31 boys, 36 girls; M_{age} = 5.8 months, SD = 0.6). Sample retention at age 12 months was 96%. Three families moved to remote locations and 3 families chose not to participate due to time constraints. The final sample at age 12 months included 144 families: 81 families of preterm infants (M_{age} = 11.8 months, SD = 0.6) and 63 families of full-term infants (M_{age} = 11.7 months, SD = 0.5). Demographic information concerning parents (age, education, occupation) is detailed in Table 1, and information concerning infants (gestational age at birth, birth weight, days of hospitalization, Apgar score [scored at 5 min after birth], number of siblings) is detailed in Table 2. No group differences were found in gender distribution, number of siblings, parents' age and occupation, or maternal education. However, fathers from the full-term group held higher educational qualifications than fathers from the preterm group (U = 2,107.5, p = .01).

Procedure

Subsequent to Helsinki Review Board approval, families were invited to participate in the study during their infants' hospitalization period. Written con-

Table 1
Parental Demographic Information by Group

	Preterm group N = 83		Full-term group N = 67	
	Mothers	Fathers	Mothers	Fathers
Age (years) M (SD)	31.8 (5.5)	33.8 (6)	30.5 (4.9)	32.4 (5.4)
Education				
< 12 years of studies	17 (14)	34.6 (28)	12 (8)	16.4 (11)
High school degree	30 (25)	24 (20)	24 (16)	25.4 (17)
College education	53 (44)	40.7 (33)	64 (43)	58.2 (39)
Occupation				
Unemployed	14.5 (12)	10.8 (9)	23.9 (16)	4.5 (3)
Unskilled worker	6 (5)	7.2 (6)	—	9 (6)
Agricultural/ manufacturing worker	—	25.3 (21)	—	21 (14)
Sales and customer service	15.7 (13)	10.8 (9)	7.5 (5)	15 (10)
Clerical work	19.3 (16)	4.8 (4)	22.4 (15)	4.5 (3)
Management position	9.6 (8)	10.8 (9)	6 (4)	9 (6)
Professional worker/technician	26.5 (22)	8.4 (7)	15 (10)	12 (8)
Academic professional	7.2 (6)	18.1 (15)	25.4 (17)	22.4 (15)

Note. Values are expressed as % (n).

Table 2
Infant Demographic Information by Group

	Preterm group, N = 83	Full-term group, N = 67
Number of siblings M (SD)	1.63 (1.3)	1.45 (1.3)
Gestational age (weeks) M (SD)	32 (1.7)	39 (1.2)
Birth weight (g) M (SD)	1,818 (475.8)	3,322.6 (426.8)
Days of hospitalization M (SD)	19.7 (13.8)	3 (1.3)
Apgar score M (SD)	9.3 (1.1)	10 (00)

sent forms were obtained from parents willing to participate, medical information was obtained, and assessments of infants' medical risk were conducted. Following infants' discharge from the hospital, data were collected in home visits when the infants were at the age of 6 and 12 months. When infants were 6 months old, each parent completed questionnaires assessing emotional distress (depression and anxiety symptoms, parenting stress). In addition, triadic (mother–father–child) interactions were videotaped during a semistructured play session using one digital video camera. At the age of 12 months, infants were given a cognitive and social evaluation by trained research assistants, and mothers were interviewed about their infants' social communication skills. At all three assessments, parents also answered several questionnaires regarding issues that are beyond the scope of this report (e.g., marital satisfaction, social support, infants' eating habits), some of which are reported elsewhere (Gueron-Sela, Atzaba-Poria, Meiri, & Marks, 2013).

Measures

Control Variables

Infant medical risk at birth. The Nursery Neurobiological Risk Score (NBRS; Brazy, Eckerman, Oehler, Goldstein, & O'Rand, 1991) was used to assess preterm infants' medical risk. The NBRS includes seven items: infection, blood pH, seizures, intraventricular hemorrhage, assisted ventilation, periventricular variation, and hypoglycemia. Each item is assessed on a 4-point scale (0 = *no evidence* to 4 = *most severe condition*) by a trained research assistant, based on the infants' medical records. The total NBRS is the sum of the scores for each item. Higher scores indicate higher levels of medical risk. A cutoff score of 6 identifies infants at high risk for abnormal outcomes. The mean NBRS score for the preterm group in the present study was 0.6 (SD = 0.97) and all scores ranged between 0 and 4, indicating that all preterm infants were at low medical risk. By definition, the full-term group included healthy infants, and therefore, the entire full-term group scored 0 on the NBRS. In addition, infants' length of hospitalization (number of days) was recorded, indicating a significantly longer period of time for preterm (M = 19.75, SD = 13.85) than for full-term (M = 3.07, SD = 1.34) infants, $t(140) = -10.77$, $p < .001$.

Infant medical risk at the age of 12 months. A medical risk index was created based on information obtained from the mothers when infants were 12 months old, regarding infants' hospitalizations and surgical procedures required since the initial discharge from the hospital. A score of 1 was given for each of the following situations: hospitalization up to 1 week, hospitalization over 1 week, experiencing a surgical procedure. A medical risk index was computed as the sum of these three scores, ranging from 0 to 3, with higher scores representing more health complications. Preterm infants (M = 0.31, SD = 0.69) scored significantly higher than full-term infants (M = 0.10, SD = 0.39) on the medical risk index $t(148) = -2.30$, $p = .02$.

Socioeconomic status. A single socioeconomic status (SES) composite was created using mothers' or fathers' highest educational level and highest occupational status. A factor analysis revealed that these two measures compounded into one factor, which explained 77% of the variance. Therefore, these two indicators were standardized and averaged to create a single SES composite, with higher scores representing higher SES. No group differences were found in SES, $t(148) = 1.5$, *ns*.

Age 6 Months

Parental emotional distress.

Depression symptoms. The Center for Epidemiological Studies Depression Scale (Radloff, 1977) is a 20-item inventory of depression symptoms. Parents were asked to report on the frequency of symptoms experienced during the past week (e.g., "I felt sad") on a 4-point Likert scale that ranges from 0 (*rarely or none of the time*) to 3 (*most or all of the time*). Higher scores indicate higher levels of depressive mood and symptoms (αs = .89 and .84 for mothers and fathers, respectively).

Anxiety symptoms. The State–Trait Anxiety Inventory (Spielberger, Gorsuch, & Lushene, 1970) is a 40-item inventory of anxiety symptoms. This study used the trait anxiety scale containing 20 items (e.g., "I have disturbing thoughts"). Higher scores indicate higher anxiety proneness (αs = .90 and .86 for mothers and fathers, respectively).

Parenting stress. The Parenting Stress Index/Short Form (Abidin, 1990) is a self-report measure for parents that assesses the degree of stress associated with their role as parents. The current study used the Difficult Child subscale, consisting of 12 items. The Difficult Child subscale focuses on the behavioral characteristics of children that make them difficult to manage (e.g., "My child gets upset easily over the smallest thing"). Higher scores indicate higher parenting stress (α = .86 for both mothers and fathers).

All three parental emotional distress indicators were significantly correlated, with r ranging between .35 and .66 ($p < .001$). A factor analysis revealed that these measures compounded into one factor, which explained 64% of the variance in maternal emotional distress and 72% in paternal emotional distress. Therefore, composites of maternal and paternal emotional distress were created by standardizing and averaging all three measures of each parent separately.

Triadic interactions. To assess triadic family interactions, the Lausanne Trilogue Play scenario (Corboz-Warnery, Fivaz-Depeursinge, Gertsch Bettens, & Favez, 1993; Fivaz-Depeursinge & Corboz-Warnery, 1999) was used. This semistructured standardized observation scenario included various triadic situations with dyadic or triadic interactions among mothers, fathers, and infants. During the observation, parents were seated facing their infant, who was in an infant seat. A box of age-appropriate soft toys was placed beside the parents. The following instructions were given:

> Please play together as a family and follow the directions for the four separate parts of the activity. In the first part, one of you plays with the child, while the other one will simply be present. In the second part, roles are reversed. In the third part, all three of you play together. In the last part, both of you will conduct a conversation and it will be the child's turn to simply be present.

The parents were allowed to decide the length of each part of the scenario. However, they were asked to keep to a time frame of 10 min for all four parts. A stopwatch was provided so that parents could keep track of time.

Coding. The triadic interactions were coded according to the Family Alliance Assessment Scale (Lavanchy Scaiola, Favez, Tissot, & Frascarolo, 2008). Three scales were used for the current study.

1. *Affect sharing*—This scale includes three criteria: family warmth, validation of child's emotional experience, and authenticity of the expressed emotions. *Family warmth* refers to the degree of positive affect sharing (mutual smiles, laughing, affectionate gestures) between family members. *Validation of the child's emotional experience* concerns parents' empathic emotional reactions toward their child, including verbal or nonverbal validation of the infant's emotional signals. *Authenticity* of the expressed affects refers to the extent the affects (negative and positive) expressed by family members are genuine and unforced.
2. *Timing/synchronization*—This scale consists of two criteria: communication mistakes during activities and communication mistakes during transitions between the four different play scenarios. *Communication mistakes during activities* refers to the family's ability to reorganize the interaction following a pause or variation in the theme of the exchange or to repair a miscoordination without interrupting the ongoing exchange activities. *Communication mistakes during transitions* evaluates the ability to fix interactive errors during change-overs between play sequences (e.g., the transition between mother–infant to father–infant play) and carry out the transition smoothly and creatively, with an announcement of this change and an explicit or implicit negotiation of this transition.
3. *Child behavior*—This scale refers to the child's behavior throughout the triadic activity and includes two criteria: involvement in play and self-regulation abilities. *Involvement* evaluates the extent to which the child's signals are clear and interpretable by the parent, as evident in use of age-appropriate visual, motor, and vocal competencies during the interaction. *Self-regulation* refers to the child's ability to engage and the extent to which he or she is able to regulate emotions (e.g., calming down quickly and maintaining an adequate level of arousal following distress).

Each of the scale criterions was rated on a 3-point scale (0 = *inappropriate*, 1 = *moderate*, 2 = *appropriate*); higher scores indicate more positive behaviors. Criterion scores were summed in order to calculate scale scores. Coding was conducted by two trained coders who did not participate in data collection and were blind to group membership. Reliability was conducted for 20% of the tapes and interrater reliability coefficients were: affect sharing = .93, timing/synchronization = .83, and child behavior = .92. A factor analysis revealed that all triadic interaction scales compounded into one factor, which explained 68% of the variance. Therefore, a composite of triadic interactions was created by standardizing and averaging all three measures.

Age 12 Months

Infant social functioning. Infant social functioning at 12 months of age was assessed by an observational measure and a parental report measure.

Observational measure. The Early Social Communication Scales (ESCS; Mundy et al., 2003) is a videotaped, structured observational measure assembled to assess infant's use of several nonverbal communication skills. During the assessment, infants were seated at a table facing the examiner. A set of toys, such as small wind-up toys, a comb, and a hat were presented to the infants, as described in Mundy et al. (2003). The experimenter presented and activated the toys one at a time. Intermittently, she made requests, such as: "Give it to me," "Comb my hair," or "Put the hat on my head." The experimenter also engaged the infants with social games and turn-taking opportunities. The ESCS measures of responding to joint attention (RJA), responding to behavioral requests (RBR), and responding to social interactions (RSI) were of interest in the current study. RJA refers to the infant's skill in following the tester's line of regard and pointing gestures. RBR refers to infant's response to experimenter's gestural or verbal simple commands to obtain an object or elicit an action from the child. RSI refers to the frequency of eye contact, gestures, and turn taking exhibited by a child in response to turn-taking interactions initiated by the experimenter. The tapes were coded by three coders who were trained to code the ESCS. The coders did not participate in data collection and were blind to group membership. To examine the interrater reliability, 20% of randomly selected videotapes were coded by all three coders. Interrater reliability coefficients, calculated by using interclass correlations, were RJA = .82, RBR = .90, RSI = .92.

Parental report measure. The Vineland Adaptive Behavior Scales (2nd ed.; Sparrow, Cicchetti, & Balla, 2005) is a semistructured interview administered to caregivers to assess adaptive behavior. Adaptive behavior is defined by this instrument as the development and application of abilities that are required to achieve personal independence and social competence. The current study used the Interpersonal Relationships subscale. A trained researcher administrated this scale, evaluating how individuals interact with others. The items relevant for infants at 12 months of age refer to responsiveness to others (e.g., "Shows interest in children the same age"), imitation skills (e.g., "Imitates simple movements like hand clapping or waving goodbye"), and social communication abilities (e.g., "Makes or tries to make social contact [smiles, makes noises]"). Items were scored from 0 to 2, with lower scores indicating skills/behaviors that are sometimes or never performed. Norm-referenced standard scores with scores ranging from 20 to 160, with a mean of 100 and a standard deviation of 15, were calculated based on the norms provided by the publisher (Sparrow et al., 2005).

A single social outcome composite was created by standardizing and averaging the ESCS scores and the interpersonal relationships scale. A factor analysis revealed that these measures compounded into one factor, which explained 46% of the variance.

Infant cognitive functioning. The cognitive scale from the Bayley Scales of Infant Development (3rd ed.; Bayley, 2006) was used to assess the infant's cognitive functioning. The Bayley scales are an individually administered instrument that assesses developmental functioning of infants and young children. The cognitive scale includes items assessing competencies such as exploration and manipulation, object relatedness, and memory. During assessment, the infant was seated at a table facing the examiner. Depending on the infant's successful completion of a certain presented task, each item was rated on a 2-point scale (0 = *no successful completion*, 1 = *successful completion*). The total cognitive scale raw score is the sum of all item scores. Norm-referenced composite scores, with scores ranging from 40 to 160, with a mean of 100 and a standard deviation of 15, were calculated based on the norms provided by the publisher (Bayley, 2006).

Analyses Plan

A priori sample size calculations were conducted in order to determine the minimum sample size required for conducting the statistical analyses. Based on previous studies (e.g., Martinez-Torteya, Bogat, von Eye, & Levendosky, 2009) medium effect sizes (d = .5) and 0.8 statistical power were desired. As the regression analyses were planned to involve not more than 10 predictors (i.e., control variables, group variable, caregiving variables, and interaction terms), the minimum number of participants required was 118 (Cohen, Cohen, West, & Aiken, 2003).

In order to control for possible effects of infants' medical risk level and the families' SES, which have both been negatively linked to child cognitive and social functioning and parent–child interactions (Bradley & Corwyn, 2002), these two variables were entered as covariates in the analyses.

The analytic strategy included two parts. First, preliminary analyses were conducted including evaluation of correlations between study variables

and the control variables as well as correlations among all study variables for preterm and full-term infants. In addition, group differences in study variables were evaluated. Second, testing hypotheses, we examined whether preterm infants and full-term infants were differentially susceptible to the effects of the caregiving environment on their cognitive and social outcomes. Differential susceptibility was tested based on recommendations suggested by Roisman et al. (2012). Specifically we used multiple regression analyses to evaluate the interaction effects of group (preterm vs. full-term) and the caregiving environment variables (i.e., parental emotional distress and triadic interaction) on infants' cognitive and social outcomes. Prior to conducting such regression analyses, all continuous predictor variables were centered by subtracting the sample mean from all individuals' scores on the variable in order to reduce the multicollinearity between predictors and interaction terms and to facilitate the testing of simple slopes. The regression analyses consisted of three steps: In the first step, control variables were entered (e.g., infants' medical risk level and the families' SES). In the second step, group (preterm/full-term) and caregiving (e.g., maternal emotional distress) variables were entered. In the third step, the interaction terms (e.g., Group × Maternal Emotional Distress) were entered. Next, to understand the nature of the interaction effects, significant interactions were probed conditional upon both the moderator (i.e., preterm/full-term) and the predicting caregiving variables by estimating simple slopes at ± 2 *SD* of the caregiving variable from the mean (Roisman et al., 2012), followed by the regions of significance (RoS) analysis. The RoS usually refers to the range of values of the moderator for which the independent and dependent variables are significantly associated. In the present study, because the moderator was a dichotomous variable (full-term/preterm) the RoS analysis was examined looking at the values for which the predicting variables (i.e., each of the caregiving environment variables) were significantly related to the outcome variables (i.e., child cognitive and social outcomes) for the different levels of the moderator (preterm vs. full-tem). The advantage of employing the RoS analysis is that these regions describe all possible values of the independent variable for which the regression is significant, instead of probing only two values (i.e., traditional simple slopes analyses, which refer only to two values, typically 1 *SD* above and below the mean), thus increasing the chances of identifying interactions that occur under either very poor or very beneficial environmental conditions (Kochanska et al., 2011). A differential susceptibility effect was inferred when the association between group and child outcome was significant at both the low and high ends of the distribution of the caregiving environment variable. A diathesis–stress model was inferred when the interaction was significant only on the low end of the distribution (Roisman et al., 2012).

Finally, in order to carry out a comprehensive examination of differential susceptibility, we also used an index for identifying differential susceptibility effects suggested by Roisman et al. (2012), namely, the Proportion of the Interaction (PoI). The PoI expresses the proportion of the total interaction that is represented on the right side of the crossover point for the interaction. In differential susceptibility theory, this represents the area for which the effect of the independent variable on the dependent variable is "for better." PoI values close to 0.50 suggest strong evidence for differential susceptibility, whereas values closer to 0 suggest evidence for diathesis–stress. In the current study, as values on the right side of the distribution represented high levels of emotional distress (i.e., effects "for worse"), in the case of parental emotional distress, maternal and paternal emotional distress composites were reversed before performing the regression analyses and RoS so that *low* scores reflected *high* emotional distress and *high* scores represented *low* emotional distress, enabling the use of the PoI measure as an indicator positive "for better" effects.

Results

Preliminary Analyses

First, associations between control variables and study variables were assessed (Table 3). Modest to moderate correlations were found between SES and the triadic interaction composite, as well as between infants' cognitive and social functioning at 12 months of age. Paternal emotional distress was moderately correlated with infant medical risk at birth, hospitalization length, and infant medical risk index at age 12 months. Therefore, all analyses including these variables were conducted while controlling for SES and the relevant infant medical risk measures. Next, we examined the correlations among the studied constructs by group (Table 4). As seen in Table 4, in the preterm group, maternal emotional distress and triadic interaction were not correlated with each other, but were both moderately correlated with child cognitive and social

Table 3
Bivariate Correlations Between Study Variables and Control Variables

	NBRS (birth)	Hospitalization length (birth)	MR (12 months)	SES
Maternal emotional distress (6 months)	.07	.12	.00	−.12
Paternal emotional distress (6 months)	.38***	.20*	.17*	−.21*
Triadic family interaction (6 months)	−.05	.00	−.13	.45***
Infant cognitive functioning (12 months)	−.08	−.12	−.16	.28**
Infant social composite (12 months)	.03	−.03	−.07	.17*

Note. NBRS = Nursery Neurobiological Risk Score; MR = medical risk; SES = socioeconomic status.
*$p < .05$. **$p < .01$. ***$p \leq .001$.

Table 4
Bivariate Correlations Between Study Variables by Group

	Maternal emotional distress (6 months)	Paternal emotional distress (6 months)	Triadic interaction (6 months)	Infant cognitive outcome (12 months)	Infant social outcome (12 months)
Maternal emotional distress (6 months)	—	.34**	−.05	−.35***	−.32**
Paternal emotional distress (6 months)	.15	—	−.05	−.12	−.11
Triadic interaction (6 months)	−.22	−.01	—	.35**	.42***
Infant cognitive outcome (12 months)	−.00	.04	.17	—	.54***
Infant social outcome (12 months)	−.02	−.06	.01	.42***	—

Note. Values above the diagonal represent correlations among the preterm group; those below the diagonal represent correlations among the full-term group.
**$p < .01$. ***$p \leq .001$.

outcomes. However, these correlations were not evident in the full-term group. Paternal emotional distress was not correlated with either child cognitive outcome or child social outcome in both groups and, therefore, was not entered into the following regression analyses.

Univariate analyses were conducted to evaluate group differences in study variables. A single group difference was found, $F(1, 128) = 5.3$, $p = .02$, in infants' cognitive outcome at the age of 12 months: Preterm infants ($M = 107.10$, $SD = 11.40$) scored significantly lower than full-term infants ($M = 113.20$, $SD = 11.30$) on the cognitive assessment. No group differences were found between the preterm and full-term groups on maternal, $F(1, 149) = 0.14$, *ns*, and paternal, $F(1, 138) = 2.42$, *ns* emotional distress and triadic interaction, $F(1, 133) = 0.11$, *ns*, at the age of 6 months, and infants' social outcome, $F(1, 144) = 0.08$, *ns*, at the age of 12 months.

Moderation Analyses

To examine the study's hypothesis, which proposed that group would moderate the links between parental emotional distress, triadic family interaction, and infants' cognitive and social outcomes, hierarchical regression analyses were conducted.

Infants' Cognitive Outcomes

The regression consisted of three steps: In the first step, SES was entered as a covariate. In the second step, group (preterm/full-term) and maternal emotional distress were entered. In the third step, the interaction variable (Group × Maternal Emotional Distress) was entered. As seen in Table 5, group and Group × Maternal Emotional Distress significantly predicted infants' cognitive functioning.

It should be noted that the regression coefficients remained similar with and without including SES

Table 5
Regression Analyses: Group, Maternal Emotional Distress, and Triadic Interaction Predicting Infant Cognitive Outcome

Predictors	β	R^2	*F*
Step 1			
SES	.30***	.10	13.1***
Step 2			
SES	.21*	.15	5.5***
Group	−.18*		
Maternal emotional distress	.07		
Triadic interaction	.15		
Step 3			
SES	.21*	.19	4.6***
Group	−.20*		
Maternal emotional distress	−.10		
Triadic interaction	.08		
Group × Maternal Emotional Distress	.25*		
Group × Triadic Interaction	.10		

Note. SES = socioeconomic status.
*$p < .05$. ***$p \leq .001$.

as a covariate in the regression analysis. Furthermore, in order to reassure that the links between group and maternal emotional distress do not vary as a function of SES, the interactions between SES and the predicting variables (i.e., SES × Group and SES × Maternal Emotional Distress) were examined. These interaction coefficients were not significant and the results overall remained similar.

Next, to probe the interaction effect, we first estimated the simple slopes for premature and full-term infants, separately. These analyses revealed a significant slope for preterm infants ($B = 0.41$, $p = .002$), but not for the full-term infants ($B = -0.00$, *ns*). Then, simple slopes for high (+2 *SD*) and low (−2 *SD*) levels of maternal emotional distress were estimated. This analysis revealed that the association between group and cognitive functioning was significant under high levels of maternal emotional distress ($B = -1.27$, $p \leq .001$), but not under low levels of maternal emotional distress ($B = 0.49$, *ns*). Following that, RoS was calculated. It was found that the lower and upper bounds of RoS of maternal emotional distress were 0.14 and 11.61, respectively. This indicates that the regression line of preterm infants was significantly different from the regression line of full-term infants for all possible points when the score of maternal emotional distress was higher than 11.61 or lower than 0.14. The shaded area illustrated in Figure 1a represents the RoS within ±2 *SD* of the maternal emotional distress mean score. While the lower bound of RoS fell within the −2 *SD* range, the higher bound fell above +2 *SD*. Consequently, it can be inferred that preterm infants showed significantly lower cognitive functioning scores if their mothers experienced high levels of emotional distress (scores below .14), supporting the diathesis–stress model. However, it should be noted that when preterm infants were exposed to lower levels of maternal emotional distress (scores higher than .14), their cognitive functioning was not different from full-term infants.

With regard to the differential susceptibility indices, PoI was less than 0.50 (0.23), providing further evidence for a diathesis–stress effect.

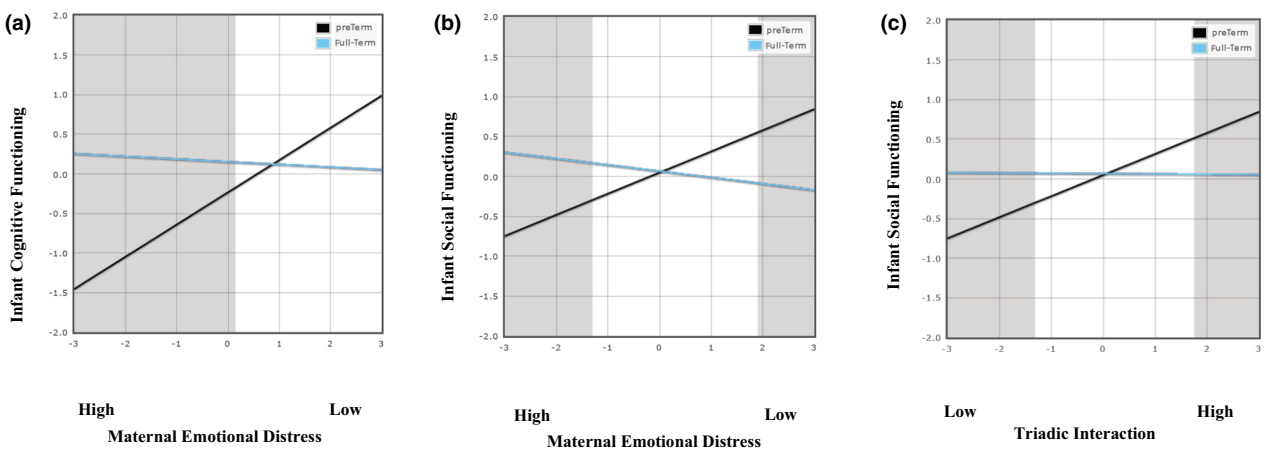

Figure 1. Regions of significance (RoS) analyses for: (a) the interaction between group and maternal emotional distress on infants' cognitive functioning, (b) the interaction between group and maternal emotional distress on infants' social functioning, (c) the interaction between group and triadic interaction on infants' social functioning. The shaded area represents the RoS: the values of maternal emotional distress/triadic interaction for which group and infant cognitive/social functioning are significantly related. In Figure 1a and 1b, values on the left represent high levels of emotional distress, and values on the right represent low levels of emotional distress.

Infants' Social Outcomes

Next, similar regression models were examined in the prediction of infants' social development. As seen in Table 6, the interaction terms Group × Maternal Emotional Distress and Group × Triadic Interaction were the only significant predictors of child social outcome. It should be noted that the regression coefficients remained similar with and without including SES as a covariate. As described above, the interactions between SES and the predicting variables (i.e., SES × Group, SES × Maternal Emotional Distress, and SES × Triadic Interaction) were also examined as predictors. However, these interaction coefficients were not significant and the overall regression model remained similar.

First, the interaction effect Group × Maternal Emotional Distress was probed by estimating simple slopes for preterm and full-term infants. This analysis revealed a significant slope for preterm infants ($B = 0.26$, $p = .009$), but not for full-term infants ($B = -0.08$, *ns*). Then, simple slopes for high (+2 *SD*) and low (−2 *SD*) levels of maternal emotional distress were estimated. This analysis revealed that the association between group and social functioning was significant under both low ($B = 0.67$, $p = .04$) and high ($B = -0.71$, $p = .03$) levels of maternal emotional distress. Following that, RoS was calculated. It was found that the lower and upper bounds of RoS of maternal emotional distress were 1.90 and −1.29, respectively. This indicates that the regression line of preterm infants was significantly different from the regression line of full-term infants for all possible points when the score of maternal emotional distress was lower than −1.29 or higher than 1.90. The shaded area seen in Figure 1b represents the RoS within ±2 *SD* of the maternal emotional distress mean score. Both lower and upper bounds of RoS fell within the ±2 *SD* range. It appears that when exposed to high maternal distress (scores below −1.29), preterm infants scored significantly lower on the social functioning outcome than full-term infants. However, when exposed to low maternal distress (scores above 1.90), preterm infants scored significantly higher on the social functioning outcome than full-term infants. In addition, PoI was 0.48, indicating that nearly 50% of the interaction is represented on each side of the crossover point of the interaction. This pattern of results is consistent with the differential susceptibility model.

Second, the interaction effect Group × Triadic Interaction was probed by estimating simple slopes for preterm and full-term infants. This analysis revealed a significant slope for preterm infants ($B = 0.27$, $p = .002$), but not for full-term infants ($B = -0.00$, *ns*). Then, simple slopes for high (+2 *SD*) and low (−2 *SD*) levels of triadic interaction were estimated. This analysis showed that the association between group and social functioning was significant under both low ($B = -0.56$, $p = .03$) and high ($B = 0.52$, $p = .04$) levels of triadic interaction. Following that, RoS was calculated. It was found that the lower and upper bounds of RoS of triadic interaction were −0.56 and 0.52, respectively, indicating that the regression line of preterm infants was significantly different from the regression line of full-term infants for all possible points when the score of maternal emotional distress was lower than −0.56 or higher than 0.52. The shaded area illustrated in Figure 1c represents the RoS within ±2 *SD* of the triadic interaction mean score. Both lower and upper bounds of RoS fell within the ±2 *SD* range. It appears that when exposed to low-quality triadic interactions (scores below −0.56), the preterm infants scored significantly lower on the social functioning outcome than full-term infants. However, when exposed to high-quality triadic interactions (scores above 0.52), preterm infants scored significantly higher on the social functioning outcome than full-term infants. In addition, PoI was 0.48, indicating that nearly 50% of the interaction is represented on each side of the crossover point of the interaction. Similar to the case of maternal emotional distress, this pattern of results is consistent with the differential susceptibility model.

Table 6
Regression Analyses: Group, Maternal Emotional Distress, and Triadic Interaction Predicting Infant Social Outcome

Predictors	β	R^2	*F*
Step 1			
SES	.16	.03	4.2*
Step 2			
SES	.07	.07	2.5*
Group	.00		
Maternal emotional distress	.08		
Triadic interaction	.19*		
Step 3			
SES	.07	.16	3.7**
Group	−.02		
Maternal emotional distress	−.11		
Triadic interaction	−.00		
Group × Maternal Emotional Distress	.28*		
Group × Triadic Interaction	.28*		

Note. SES = socioeconomic status.
*$p < .05$. **$p \leq .01$.

Discussion

The current study contributes to the growing body of research on the intriguing issue of understanding interactions between child risk or susceptibility factors and the quality of the caregiving environment in children's development (e.g., Kim & Kochanska, 2012; Poehlmann et al., 2011). To the best of our knowledge, this study was the first to systematically examine prematurity as a potential susceptibility factor to parenting. Overall, preterm infants were more strongly affected by the quality of their caregiving environment compared to their full-term counterparts. However, the pattern of the interactions between group and the caregiving environment differed between cognitive and social outcomes: While the cognitive outcome was consistent with the diathesis–stress model, the social outcome was consistent with the differential susceptibility model.

Infants' Cognitive Outcomes: Evidence for Diathesis–Stress

Our results indicated that prematurity acted as a risk factor in infants' early cognitive development. By the age of 12 months, infants born prematurely scored significantly lower in the cognitive assessment than infants born at full-term. This finding is consistent with previous research suggesting that even under low medical risk conditions, as a group, infants born preterm score lower than full-term infants on standard cognitive assessments (Brummelte et al., 2011). The cognitive disadvantage exhibited by preterm infants may be attributed to the adverse effects premature birth has on early brain development (e.g., alterations in myelination, synaptogenesis, and cortical connectivity), even in the absence of major brain injuries (Aylward, 2005). In addition, preterm infants are exposed to high levels of medical stress in the NICU (e.g., extended hospitalization period, invasive and painful medical treatments; Simons et al., 2003) and to more social stress (i.e., less maternal proximity and contact; Feldman, Weller, Sirota, & Eidelman, 2002) than infants who are born full-term, which may negatively affect their early cognitive development (de Jong, Verhoeven, & van Baar, 2012). Although in the current study the links between infants' medical risk indices and cognitive functioning were not significant, a more specific measurement of pain and invasive procedures experienced during the hospital stay may explain the differences in cognitive functioning between the groups.

The post hoc RoS analysis indicated that the caregiving environment had a significant role in enhancing or, alternatively, reducing the risk for low cognitive functioning among preterm infants. That is, preterm infants who were exposed to high levels of maternal emotional distress at the age of 6 months had significantly lower cognitive scores at the age of 12 months than full-term infants. However, when exposed to low levels of maternal emotional distress, these differences in cognitive outcomes were no longer present and preterm infants' cognitive functioning was no different from full-term infants. Conversely, full-term infants' cognitive functioning was not related to earlier maternal emotional distress levels. This pattern of results is consistent with the diathesis–stress approach (Monroe & Simons, 1991) for understanding interactions between risk factors.

Previous research examining diathesis–stress versus differential susceptibility patterns of interactions generally supports diathesis–stress effects of parenting on infants' cognitive functioning. For example, research examining the interaction between children's genotypes and maternal responsive care revealed that among children with a short *5-HTTLPR* allele, early exposure to unresponsive maternal care predicted low academic performance (Kochanska et al., 2011). However, when exposed to responsive maternal care, no differences were found in academic performance between children with or without a short *5-HTTLPR* allele (Kochanska et al., 2011). Moreover, results from the National Institute of Child Health and Human Development Study of Early Child Care and Youth Development suggest that the interaction between children's difficult temperament and maternal sensitivity is consistent with the diathesis–stress model in predicting academic skills using objective tests (Roisman et al., 2012). Although previous research has established that elevated levels of emotional distress are associated with lower cognitive functioning among preterm infants (McManus & Poehlmann, 2012), this study was the first to include a full-term group, which enabled a comparison with normative developmental functioning and uncovered a diathesis–stress effect of prematurity.

Infants' Social Outcomes: Evidence for Differential Susceptibility

Our findings provide support for a differential susceptibility effect on infants' social outcomes. Preterm infants who were exposed to high mater-

nal stress or low quality triadic interaction at the age of 6 months demonstrated the lowest social competence at the age of 12 months, whereas preterm infants exposed to low stress or high-quality triadic interaction demonstrated the highest social competence, outperforming their full-term counterparts. Previous research has generally supported the finding that social competence may be affected differentially by the quality of the caregiving environment. It has been demonstrated that preterm infants who were more prone to distress and who experienced negative parenting exhibited the most internalizing behaviors, whereas distressed infants who did not experience negative parenting exhibited the least internalizing behaviors compared to nondistressed infants (Poehlmann et al., 2011). An additional study, which tested biological reactivity to stress as a susceptibility factor, found that high-reactive children showed lower levels of prosocial behavior in the context of high family stress, but in the context of low stress showed higher levels of prosocial behavior compared to low-reactive children who were not affected by exposure to family stress (Obradovic et al., 2010).

The current study extends the knowledge of the interplay between prematurity and the caregiving environment by innovatively considering prematurity not only as a risk factor but as a possible *plasticity* factor. Although previous research focused on the negative risk associated with a premature birth (e.g., Brummelte et al., 2011), findings from the current study suggest that there may also be highly positive outcomes in the case of low-medical-risk preterm infants.

Cognitive and Social Outcomes: Differential Effect of the Caregiving Environment

Findings from the current study raise two important questions. First, *why* are preterm infants more strongly affected by their environments than full-term infants, and second, *how* does the effect on cognitive development differ from the effect on social development?

Why Are Preterm Infants More Strongly Affected by Their Environments Than Full-Term Infants?

Both the differential susceptibility (Belsky et al., 2007) and the biological sensitivity to context (Boyce & Ellis, 2005) theories suggest that susceptibility to the environment is originated in the biology of the nervous system and may be defined as neurobiological susceptibility, which is determined by developmental experiences and/or genetic predisposition (Ellis, Boyce, Belsky, Bakermans-Kranenburg, & van IJzendoorn, 2011). Premature birth is often associated with abnormalities in brain white matter such as changes in synaptic efficacy, loss of volume, enlarged ventricles, and alterations in the degree of myelination (Inder et al., 2005) that may result in difficulties in biological and behavioral regulation (Brown et al., 2006; Woodward et al., 2011). Therefore, preterm infants may be more dependent on their environments in order to regulate their behavior than full-term infants, and as a result they may be more affected by their caregivers' emotional states and behavior.

Another possible explanation is that the overall stronger relations between the caregiving variable and infants' outcomes are due to group differences in parental distress and triadic interaction. Specifically, it is possible that parents of preterm infants experience higher levels of emotional distress and less positive triadic interactions than parents of full-term infants (Feeley et al., 2007), and thus have a more negative influence on their infants' development. Alternatively, it is possible that parents of preterm infants, being aware to their infants' vulnerability, may put more effort in providing developmentally appropriate stimulation to compensate for their infants' initial difficulties, resulting in infants' higher functioning. However, in the current study, there were no mean-group differences in parental emotional distress and triadic interactions. Furthermore, the variance in emotional distress and triadic interaction did not differ between the two groups. Therefore, the different associations found for the two groups cannot be due to differences in initial caregiving situation. With that said, there may be additional parental variables that were not measured in this study that can support the idea of parental/family (in addition to child) susceptibility.

How Does the Effect on Cognitive Development Differ From the Effect on Social Development?

Preterm infants' initial neurological risk may also explain the differential effect of the caregiving environment on cognitive and social outcomes. It is theorized that both early cognitive and social abilities develop in the context of the early parent–child relationship (Sroufe, 1996). Yet, the role of infant biological factors (i.e., early medical risk condition) may be more detrimental for cognitive abilities than for social abilities (Bendersky & Lewis, 1994). Initial abruptions in the development of the prefrontal cortex among preterm infants, even in the absence

of severe neurological complications (Pickler et al., 2010), may result in difficulties in executive functions, such as lower working memory, inhibition, and planning abilities, compared to full-term infants, as early as 8 months of age (Sun, Mohay, & O'Callaghan, 2009). Cognitive functioning in the 1st year includes abilities such as attention to novelty, habituation, memory, and problem solving (Kail, 2000), which all strongly rely on executive functions. Thus, preterm infants' initial neurological risk may set an upper threshold to the degree by which a supportive environment can enhance cognitive abilities. In contrast, social communication abilities may be less associated with biological risk factors (Bendersky & Lewis, 1994); thus, the extent by which social development is affected by the environment is less limited than in the case of cognitive development.

An additional explanation for the differential effects of the environment on cognitive and social development may be that intellectual abilities (in particular, executive functions) are more genetically determined than social abilities (Friedman et al., 2008). Thus, there may be an upper threshold for cognitive development that is predetermined. As for social abilities, although there is evidence to suggest that genetics contribute to social development (Knafo & Plomin, 2006), environmental influences play a major role, questioning the notion of a predetermined upper threshold for social development (Hughes et al., 2005). However, these explanations are currently hypothetical and need to be tested empirically in future research.

Fathers' emotional distress was not linked to infants' cognitive and social outcomes, and, therefore, was not tested as a potential susceptibility factor. This may possibly be explained by the young age examined in the current study. That is, within the 1st year of life, infants spend more time with their mothers than fathers; consequently, their learning environment is more strongly related to their interactions with their mothers, and their exposure to the global, affective context in the home is shaped by mothers' emotional states, as seen in the positive correlation between maternal emotional distress and preterm infants' cognitive and social outcomes. At this stage, fathers may mainly affect children indirectly through mothers, as evident in previous research (e.g., Cabrera et al., 2011). However, interestingly, preterm infants' medical risk was positively associated with fathers' (but not mothers') emotional distress levels. This finding implies that fathers' emotional well-being may be more susceptible to their infants' medical situation. Future research may focus on understanding the different processes that underlie emotional coping between mothers and fathers of preterm infants.

Finally, SES was linked to several variables in the study. Furthermore, SES has been previously associated with a wide range of cognitive and socioemotional outcomes in children, and part of these observed links may reflect parental stress and styles of interaction with children (Bradley & Corwyn, 2002). Therefore, all of the analyses in this study were conducted while controlling for SES. It should be noted, though, that the interactions between group and the caregiving environment variables (i.e., maternal emotional distress and triadic interaction) remained similar with and without including SES as a covariate. This implies that the interaction effects and SES are independent predictors of infants' cognitive and social outcomes. That is, infants born preterm seem to be more strongly affected by their caregiving environments than full-term infants, regardless of their SES.

Limitations and Conclusions

Findings from the current study need to be considered in light of several limitations. First, it should be highlighted that the preterm infants who participated in this study were healthy infants, with low medical and neurological risk. Preterm infants' susceptibility to the caregiving environment may vary depending on the degree of prematurity and medical risk, as has been recently suggested (Shah et al., 2013). Therefore, these results should not be generalized and need to be tested on high-risk preterm samples as well. Second, this research focused on early developmental outcomes at the age of 12 months. Although cognitive and social functioning in infancy may act as early markers for later performance (e.g., Blaga et al., 2009), to infer general conclusions about preterm infants' susceptibility patterns, we must expand our examination to later developmental stages. Finally, our sample was varied in terms of SES, but did not include extremely high-risk social conditions (e.g., domestic violence, substance abuse, psychiatric disorders). Exposure to extreme environmental circumstances may exert negative effects on children's outcomes among both preterm and full-term infants. Therefore, we may only conclude that preterm infants were more affected by their caregiving environment within the normal range of environmental functioning.

Despite the above limitations, the current study contributed to the understanding of the processes

underlying adaptive and maladaptive developmental outcomes in a high-risk population of infants. Exploring both cognitive and social outcomes enabled us to uncover the specificity of environmental effects on developmental outcomes. Our findings demonstrated that prematurity may act as a susceptibility factor, enhancing above-average social functioning in the context of low-stress, supportive environments. In addition, it was demonstrated that a low-stress environment may reduce the cognitive gap between preterm and full-term infants. These findings may provide new directions for the type of medical surveillance and care provided for preterm infants. Specific focuses during routine health surveillance could include monitoring for symptoms of maternal emotional distress and screening for early cognitive delay, even among low-medical-risk infants. Moreover, due to the fact that preterm infants demonstrated high cognitive and social functioning in the context of more optimal triadic family interactions, they may uniquely benefit from interventions supporting the quality of early family interactions.

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