The Impact of Premature Childbirth on Parental Bonding

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Abstract: The development of an affectionate parent-infant bond is essential for a newborn infant’s survival and development. However, from evolutionary theory it can be derived that parental bonding is not an automatic process, but dependent on infants’ cues to reproductive potential and parents’ access to resources. The purpose of the present study was to examine the process of bonding in a sample of Dutch mothers (n = 200) and fathers (n = 193) of full-term (n = 69), moderately premature (n = 68), and very premature infants (n = 63). During the first month postpartum parents completed the Pictorial Representation of Attachment Measure (PRAM) and Postpartum Bonding Questionnaire (PBQ). Longitudinal analyses revealed that mothers’ PRAM scores decreased after moderately preterm delivery, whereas decreases in PRAM scores occurred in both parents after very preterm delivery. As lower PRAM scores represent stronger feelings of parent-infant connectedness, our findings suggest a higher degree of bonding after premature childbirth. Results of the PBQ analysis were in line with PRAM outcomes, as parents of preterm infants reported less bonding problems compared to parents of full-terms. These findings support the hypothesis that in affluent countries with adequate resources, bonding in parents of preterm infants on average may be higher than in parents of full-term infants.
Keywords: bonding, investment, prematurity, parents, postpartum period

Introduction

Compared to all other species, human neonates are particularly immature, helpless and reliant on parental investment (Zeveloff and Boyce, 1982). This extreme altriciality makes infants require extensive care for many years, as to feeding, protection, stimulation, and affection (Pavard, Koons and Heyer, 2007; Pavard, Sibert, and Heyer, 2007). The process of bonding, in which parents form an emotional bond or tie with their infant, is thus essential for the infant’s survival and development, as the development of an affectionate parent-infant relationship enhances parental investment (Hrdy, 1999; Kennell and Klaus, 1998).

However, that is not to say that parental bonding and commitment to offspring is an innate and automatic process. The essentialist presumption that parents, in particular mothers, are genetically pre-programmed to nurture babies has been subverted by the observation that parents may be reluctant to take care of their offspring (Daly and Wilson, 1984, 1988; Hrdy, 1999). Parents may love their newborn baby deeply and passionately, but often not unconditionally, in order to maximize investment returns (Hrdy, 1999; Solomon and George, 1996). Cross-cultural research shows that parental neglect, abuse and even infanticide do occur in infants with poor survival prospects, either due to ill health or detrimental circumstances (Daly and Wilson, 1984, 1988; Soltis, 2004).

From an evolutionary perspective, parental investment depends on the total energy and resources that a specific infant requires at the expense of other offspring or family members (Trivers, 1972). Both the parent’s and infant’s reproductive value, as well as the impact of the investment on the infant, seem to influence parental investment decisions, along with circumstances parents are in, such as their access to resources (Daly and Wilson, 1984, 1988; Salmon, 2005; Trivers, 1972). Since parents have the ability to distinguish infant characteristics linked to reproductive potential and consider outcomes in this respect, parental bonding may be affected by certain features and health status of the infant (Hrdy, 1999; Kennell and Klaus, 1998; Miles, Funk, and Kasper, 1991; Soltis, 2004). In particular uncertainty about the health- and developmental outcome of an infant may delay and disrupt bonding in parents (DeMier et al., 2000). As a way of coping, and in an attempt not to be overwhelmed by emotions, parents of sick and premature infants may keep their infant at a distance or, alternatively, over stimulate their infant to elicit a reassuring reaction from their baby (Borghini et al., 2000; Feldman and Eidelman, 2006; Muller-Nix and Ansermet, 2009; Pierrehumbert and Nicole, 2003). So, parental bonding may be delayed until the infant’s physical condition appears to be improved and the infant’s survival seems assured (Robson and Kumar, 1980). This implies that handicapped, sick, or premature infants, who require additional parental care in terms of time, money, and attention, run an increased risk of non-optimal parenting, neglect, or even abuse in comparison with their healthier counterparts (Daly and Wilson, 1984, 1988; Hrdy, 1999; Tifferet, Manor, Constantin, Friedman, and Elizur, 2007).

With prematurity (birth before 37 weeks gestation) as the most prevalent cause of
infant morbidity and mortality in industrialized countries (Muller-Nix and Ansermet, 2009; WHO global action report, 2012), preterm infants represent a vulnerable group at risk for parental withdrawal of investment. With an estimated incidence rate of 11.1% worldwide, preterm birth is considered to be a global public health problem. Variation in preterm birth rates among regions and countries is considerable, but on average rates are highest in low- and lower middle-income countries (11.8% and 11.3%), and lowest in upper middle- and high-income countries (9.4% and 9.3%; WHO global action report, 2012).

Preterm birth is increasingly acknowledged as a very emotional, stressful and demanding experience for parents (Muller-Nix and Ansermet, 2009). During the days, weeks or even months of hospitalization of a premature infant, parents are often overwhelmed by a range of emotions, from feelings of helplessness, anxiety and depression, to frustration, guilt, and anger (Muller-Nix and Ansermet, 2009). In parents of preterm infants, especially the visible, external infant characteristics and signals associated with immaturity and severity of medical status can cause apprehension and impaired bonding, as they indicate reduced survival chances (DeMier et al., 2000; Hrdy, 1999; Muller-Nix and Ansermet, 2009; Young Seideman et al., 1997). With their low birth weight and less infantile (“babyish”) facial features, the appearance of preterm infants is judged as less cute and physically attractive than the features of full-terms (Hildebrandt and Fitzgerald, 1979; Goldberg and DiVitto, 2002). Moreover, parents might encounter difficulties in interacting with their immature preterm infant, as they are relatively irritable, show mixed behavioral signs, and exhibit more sensory-defensive behaviors; while at the same time being less active, alert, and responsive to parents’ solicitations than full-term infants (Case-Smith, Butcher and Reed, 1998; Eckerman, Hsu, Molitor, Leung, and Goldstein, 1999; Friedman, Jacobs and Werthman, 1982; Goldberg and Di Vitto, 2002; Muller-Nix and Ansermet, 2009). In addition, it has been found that the crying of preterm infants, which contains information about their level of current distress as well as overall fitness, is perceived as more aversive and physiologically arousing to mothers (Frodi, Lamb, and Wille, 1981; Soltis, 2004). Consequently, all of these infant characteristics and signals can hinder parental bonding, as parents may hesitate to bond with a preterm infant with poor survival prospects and possible developmental difficulties. Emotional detachment in parents can subsequently lead to selective neglect of the infant and withdrawal of investment (Mann, 1992).

Fortunately, in developed countries today, reduced infant health status is unlikely to result in complete withdrawal of parental investment or infanticide (Daly and Wilson, 1988; Soltis, 2004). For most newborns, although highly contingent on circumstances, parental care giving is not being compromised by initially negative responses to specific infant attributes such as low birth weight, physical appearance, or infant crying. Nevertheless, the risk of delayed bonding and parental distancing as well as non-optimal parenting, including child abuse and neglect, is still increased for sick infants (Feldman, Weller, Leckman, Kuint, and Eidelman, 1999; Hrdy, 1999; Soltis, 2004).

The notion that prematurity and related compromised infant health status can impede parental care and bonding, is not a recent observation (Bell, 2001). In one of the earliest known treatises on gynecology, the Greek physician Soranus of Ephesus (circa AD 98-138) already described “how to recognize the newborn that is worth rearing”. Soranus
The impact of premature childbirth on parental bonding

(1991) provided specific criteria for midwives to distinguish healthy newborns from weak, malformed or diseased infants. He determined that the newborn “suited by nature for rearing” should have: a mother who “spent the period of pregnancy in good health”, be “born at the due time, best at the end of nine month”, should “immediately cry with proper vigor” after birth, and be “perfect in all its parts, members and senses” (pp. 79-80).

While Soranus’ evaluation system may appear obsolete and even inhuman to us at the present time, the suggested criteria still seem valid predictors of infant survival. Even though objectives are completely different, the criteria for infant fitness as provided by Soranus centuries ago show remarkable resemblance to APGAR-scores, which are currently used for newborn health assessment (Finster and Wood, 2005). Moreover, parents’ perceptions of a newborn infant, with subsequent levels of parental investment and commitment, are still affected by infant health status and prematurity (Dubas, 2010; Muller-Nix and Ansermet, 2009). Based on cognitions and perceptions parents have about their infant, they face the dilemma of whether to increase investment in their premature infant in need for additional care to improve the infant’s health outcomes, or to minimize care in order to invest in other (future or concurrent) offspring with more reproductive potential (Mann, 1992). According to Mann (1992), moderate parental investment in a high-risk infant may be the worst alternative to this trade-off, as moderate care for these infants does involve costs but with reduced investment returns.

The most important factor influencing the decision for parental investment in a premature infant is parents’ access to care giving resources (Mann, 1992; Bugental, Beaulieu and Corpuç, 2012). Resources that influence parental investment may be material (e.g. money, nutrition), social (e.g. spousal support), skill based (e.g. parenting experience), temporal (i.e., availability of time), and attentional or emotional (i.e., parental attention or emotional engagement, which is for instance dependent on parents’ own mental and physical health status) (Bugental et al., 2012; Mann, 1992; Pavard et al., 2007). With limited resources and unfavorable child rearing circumstances, parents are more likely to show reduced investment in their infant compared to parents with adequate resources (Bugental et al., 2012; Daly and Wilson, 1988; Mann, 1992). On the other hand, when parents do have access to abundant resources, they can afford to invest additional time, money and attention in a high-risk infant, while still having enough care giving resources available for other children and family members (Mann, 1992; Beaulieu and Bugental, 2008). Moreover, Bugental and Beaulieu (2003; Beaulieu and Bugental, 2008) proposed that differential parental investment in high-risk infants involves a contingent pattern, whereby parents with adequate resources are expected to even invest preferentially in a high-risk infant with low reproductive value. In that way they increase the probability of infant survival and thus their reproductive success. The authors found support for a contingent model of parental investment concerning the interactive effects of maternal attentional resources (depression) and infant risk status (prematurity). They observed that mothers with high personal resources were more likely to invest in an infant with cues to low reproductive potential (Beaulieu and Bugental, 2008).

To date, few previous studies have reported high levels of care giving in mothers of premature infants attempting to compensate for the negative consequences of preterm birth. While there still is controversy about the effect of prematurity on the parent-infant
relationship, and most researchers only emphasize the negative consequences of premature birth, increased maternal investment as well as consistent maternal attention have been demonstrated in mothers of premature children (Beckwith and Cohen, 1978; Wright and Zucker, 1980). Observations of additional parental investment in high-risk infants resulted in a theory of compensatory care, suggesting that there is increased parental care giving behavior to sick and high-risk infants to attenuate the effect of hazardous events (Beckwith and Cohen, 1978). Thus, dependent on parents’ resources, prematurity actually may stimulate more parental care and investment instead of increasing disinterest and non-attachment (Wright and Zucker, 1980). In a study among a heterogeneous sample of premature infants at one month corrected age, it was observed that infants with more serious medical problems, born with a lower birth weight and low gestational age, received more care giving behavior from their mothers compared to their healthier counterparts (Beckwith and Cohen, 1978). Also, an experimental study in which mothers of full-terms were compared to mothers of preterm infants demonstrated that mothers of premature infants, and in particular mothers who were separated from their infant immediately after birth, touched and attended more to their children than mothers of full-term infants by 21 month follow-up assessment (Leiderman, 1981; Myers, 1984).

Furthermore, there is an ongoing debate about the quality and quantity of mother-preterm infant interaction. Whereas various authors have described mothers of preterm infants as less sensitive, more intrusive, and at the same time more disengaged than mothers of full-term infants, other researchers described them as relatively competent in their interaction (Muller-Nix and Ansermet, 2009). A recent literature review by Korja, Latva, and Lehtonen (2012) revealed that 5 out of 18 studies reported an equal or even higher quality of mother-infant interaction in preterm dyads, compared to full-term dyads.

To date, there is only limited data available on fathers of preterm infants, though it has been suggested that fathers of preterm infants in the first months postpartum are more involved with their infant in comparison with fathers of full-terms (Brown, Rustia, and Schappert, 1991; Harrison, 1990). This could be explained by the fact that fathers of premature infants have a unique responsibility and supporting role, especially in the beginning when their infant is still hospitalized and the mother is recovering from pregnancy and delivery (Goldberg and DiVitto, 2002).

With prematurity as a leading global cause of perinatal mortality and disability, increasing global incidence rates of preterm birth, and increased survival rates of very preterm infants, there is growing concern for the impact of preterm childbirth on both infants and parents (Muller-Nix and Ansermet, 2009; WHO global action report, 2012). Given the fact that premature birth can be a very traumatic event for parents, with significant implications regarding parents’ representations and care giving competencies, examining the process of bonding in this population is of key importance (Pierrehumbert and Nicole, 2003). In particular, since the quality of the early parent-infant relationship is considered to be a significant mediating factor between the infant’s perinatal risk status and developmental outcome, the parent-infant bond can worsen or soften the impact of premature childbirth (Forcada-Guex, Pierrehumbert, Borghini, Moessinger, and Muller-Nix, 2006; Singer et al., 2003).

As previous studies remained inconclusive concerning the impact of preterm
childbirth on the parent-infant relationship, the purpose of the present study is to further examine the process of bonding in Dutch parents with full-term, moderately preterm, or very preterm infants on three occasions after birth. From evolutionary theory it could be derived that in the Netherlands, currently a high-income country with comparably abundant resources, parental bonding with preterm infants could on average be expected to be higher than with full-term infants. Moreover, as most research solely focuses on the mother-infant relationship, the secondary aim of the study is to explore possible differences in bonding between mothers and fathers of full-term and preterm infants. Given the findings of previous studies on the father-infant relationship, we hypothesize fathers of preterm infants to show relatively high levels of bonding as they fulfill the demanding caretaking role during the infant’s hospital stay.

Materials and Methods

Participants

This study is part of a larger longitudinal study on families with premature infants and the effectiveness of video interaction guidance after premature childbirth, conducted in eight hospitals in the Netherlands (Tooten et al., 2012). Both mothers (n = 200) and fathers (n = 193) of full-term (n = 69), moderately premature (n = 68), and very premature infants (n = 63) participated in the study, after having been invited within 24 hours after birth of their child. Infants born at less than 37 completed weeks of gestational age (GA) were classified as premature regarding international norms. Infants with less than 32 weeks GA were considered very preterm, as these infants in particular are at risk for mortality, health problems and developmental difficulties (Muller-Nix and Ansermet, 2009). Full-term infants (≥ 37 weeks GA) and moderately preterm infants (≥ 32 - < 37 weeks GA) and their parents were recruited from maternity wards of the participating hospitals. Very preterm infants (< 32 weeks GA) and their parents were recruited from the neonatal intensive care units (NICU) of two specialized hospitals. Nurses from the participating hospitals informed the parents about the design and aims of the study, while providing them a written information brochure. All parents who participated in the study gave their written consent. Parents with poor understanding of the Dutch language were excluded from participation. The study protocol was approved by the Medical Ethical Committee of the Catharina Hospital in Eindhoven. Mean dropout rate 1 month postpartum was 9%.

Measures and Procedure

To assess parent-infant bonding in parents of full-term as well as preterm infants, parents were asked to individually complete the “Pictorial Representation of Attachment Measure” (PRAM: Van Bakel, Vreeswijk, and Maas, 2009; Vreeswijk, Vingerhoets, and Van Bakel, 2010) at three measurement occasions. Van Bakel and colleagues developed this measure to assess the nonverbal representation of antenatal attachment or bonding between parents and their offspring. The PRAM is a modified version of “The Pictorial Representation of Illness and Self Measure” originally developed and validated by Büchi and colleagues (Büchi, Sensky, Sharpe, and Timberlake, 1998; Büchi et al., 2002). The concept of bonding is complex and multi-faceted in origin, yet the PRAM attempts to
provide a visual representation of the relationship between the parent and the baby. The measure consists of a white A4-format paper with a big circle in the center (diameter of 18.6 cm.). The big circle symbolizes the current life of the parent. A smaller circle (diameter of 5.3 cm.), in the middle of the big circle, represents the parent’s “self.” The task of the parents was to place a grey round sticker (diameter of 5 cm) that symbolized their newborn baby somewhere in the big circle representing their life. Parents received written instructions concerning the PRAM task, requesting them to reflect on the importance of the newborn infant for him or her. They were asked specifically “Where would you put the baby in your life at this moment?” The quantitative outcome PRAM “Self-Baby Distance” (PRAM-SBD), i.e., the distance between the midpoints of the self-circle and the baby-circle, is reported in millimeters with a possible range of 0 to 93 mm. Based on the results of Van Bakel et al. (2009) and Vreeswijk et al. (2010), lower PRAM-SBD scores are assumed to indicate a higher degree of parent-infant bonding and feelings of connectedness. Higher PRAM-SBD scores reflect more emotional distancing towards the newborn infant. This test was applied three times after birth: 1 day, 1 week, and 1 month postpartum.

In addition, all parents were asked to complete the Postpartum Bonding Questionnaire (PBQ; Brockington et al., 2001) 1 month postpartum. This instrument has been designed for early diagnosis of mother-infant relationship disorders. To further validate the PRAM and test the hypothesis that it also examines feelings of parental bonding in our study population, the convergent validity between the two measures was analyzed. Correlations between parents’ outcomes on the PRAM and the Postpartum Bonding Questionnaire (PBQ) subscale “impaired bonding” were computed 1 month postpartum, as both instruments measure related theoretical constructs. In a validation study, the PBQ subscale “impaired bonding,” consisting of 12 questions on a 6-point Likert scale, was found to be sensitive in identifying mothers with bonding disorders (Brockington, Fraser, and Wilson, 2006). In both the PRAM and PBQ, low scores reflect a higher degree of parental bonding (closeness), whereas high scores represent bonding difficulties (distance).

**Statistical Analysis**

Structural Equation Modeling (SEM) through AMOS statistical software was applied to analyze the repeatedly measured multiple group data on PRAM-SBD scores (Bollen and Curran, 2006). Full-information maximum likelihood-based parameter estimates (MLE) of observed scores were used to handle missing data. This method was selected since an analysis of the repeated measures data by means of the SPSS procedure GLM (Repeated Measures), which applies list-wise deletion of cases, would have resulted in a loss of observations and a reduction of sample size in each of the three groups. Analysis by means of the SEM program AMOS makes use of all observed scores and does not delete cases with missing scores from the data set, and provides full-information maximum likelihood estimation and hypothesis testing for the repeated measures data. In contrast to traditional ANOVA analyses, hypothesis testing is not based on F-tests but on chi-square tests. PRAM-SBD scores were analyzed for mothers and fathers simultaneously. By treating the family as the unit of analysis, PRAM-SBD outcomes of mothers and fathers
were allowed to be correlated. The analyses reported below were carried out separately for the three different groups. In parents of twins, only PRAM-SBD scores concerning the first born infant were included in the analysis. Socio-demographic and clinical data were tested for differences between the participants of the three groups using chi square analyses for categorical variables and one-way between groups analysis of variance (ANOVA) for continuous variables. Since this study was part of a larger longitudinal study on the effectiveness of video interaction guidance, we also analyzed the effect of the intervention on PRAM-SBD scores. However, this factor was not taken into account in the further analysis, because analyses failed to yield any significant differences between the experimental and the control group.

Furthermore, to establish convergent validity of the PRAM for mothers and fathers, Pearson product-moment correlations between the PRAM and the PBQ subscale “impaired bonding” were calculated 1 month postpartum by means of SPSS statistical software. In addition, one-way ANOVAs with post-hoc comparisons were conducted to analyze group differences on the mean PBQ “impaired bonding” scale scores.

Results

Infant Birth Data and Parental Demographic Data

Participants’ background characteristics for the three study groups are reported in table 1. Preliminary analyses did not reveal significant differences among the three groups on nationality and marital status of parents, nor on infant gender. Obviously, the preterm infants had significant lower gestational age \( [F(2, 193) = 737.29, p < .001] \), lower birth weight \( [F(2, 194) = 308.75, p < .001] \), lower 5-minute APGAR scores \( [F(2, 190) = 37.73, p < .001] \), more days spent in an incubator \( [F(2, 187) = 190.90, p < .001] \), along with a higher reported mortality rate in the group of very premature infants \( [F(2, 197) = 5.82, p = .004] \). Also, significantly more premature infants were part of a twin pair \( [X^2 = 9.62, p = .008] \). Furthermore, significant differences were found between the three groups on parental educational level, as parents of premature infants were on average lower educated [maternal educational level: \( F(2, 190) = 7.41, p = .001 \); paternal educational level: \( F(2, 178) = 3.30, p = .039 \)]. Parents of premature infants were on average also younger [maternal age: \( F(2, 191) = 5.10, p = .007 \); paternal age: \( F(2, 180) = 3.83, p = .023 \)]. In addition, premature infants were more often first born children for mothers (with twin birth counted as a single event) [birth order mothers: \( F(2, 192) = 5.82, p = .004 \)]. Given these significant differences among the three groups, we checked whether these variables were significantly related to PRAM-SBD baseline scores. Regression and multivariate analyses did not reveal any significant relations among group, parental demographic variables (i.e., educational level, age and birth order) and PRAM baseline findings.
Table 1. Characteristics of study participants

|                          | Full-term infants | Moderately preterms | Very preterms | Total |
|--------------------------|-------------------|---------------------|---------------|-------|
|                          | $n = 69$          | $n = 68$            | $n = 63$      | $n = 200$ |
| **Infant birth data**    |                   |                     |               |        |
| Gender                   |                   |                     |               |        |
| Male ($n$)               | 35 (50.7%)        | 39 (57.4%)          | 34 (54%)      | 108 (54%) |
| Female ($n$)             | 34 (49.3%)        | 29 (42.6%)          | 29 (46%)      | 92 (46%) |
| GA at birth (mean, wk)   | 39.49             | 34.50               | 29.38         | 34.61 |
| GA at birth (range)      | 37 - 42.14        | 32.14 – 36.71       | 25.14 – 32.14 | 25.14 – 42.14 |
| Birth weight (mean, gr)  | 3405              | 2293                | 1293          | 2362 |
| Birth weight (range)     | 1775 - 4865       | 1220 - 4280         | 556 - 2220    | 25.14 – 4865 |
| 5-min APGAR (mean)       | 9.65              | 9.23                | 7.9           | 8.96 |
| Incubator (mean, days)   | 0.28              | 7.89                | 39.16         | 14.38 |
| Singleton ($n$)          | 66 (95.7%)        | 55 (80.9%)          | 49 (77.8%)    | 170 (85%) |
| Deceased infants ($n$)   | 0 (0%)            | 0 (0%)              | 5 (7.9%)      | 5 (2.5%) |
| **Maternal demographic data** |               |                     |               |        |
| Mothers ($n$)            | 69 (100%)         | 68 (100%)           | 63 (100%)     | 200 (100%) |
| Maternal age (mean, yr)  | 33.57             | 31.39               | 31.08         | 32.06 |
| Birth order (mean)       | 1.65              | 1.39                | 1.27          | 1.45 |
| Nationality Dutch ($n$)  | 63 (91.3%)        | 66 (97.1%)          | 58 (92.1%)    | 187 (93.5%) |
| Educational level ($n$)  |                   |                     |               |        |
| Low                      | 6 (8.7%)          | 11 (16.2%)          | 12 (19%)      | 29 (14.5%) |
| Medium                   | 15 (21.7%)        | 27 (39.7%)          | 25 (39.7%)    | 67 (33.5%) |
| High                     | 48 (69.6%)        | 28 (41.2%)          | 21 (33.3%)    | 97 (48.5%) |
| Unknown                  | 0 (0%)            | 2 (2.9%)            | 5 (7.9%)      | 7 (3.5%) |
| **Paternal demographic data** |               |                     |               |        |
| Fathers ($n$)            | 68 (98%)          | 66 (97.1%)          | 59 (93.7%)    | 193 (96.5%) |
| Paternal age (mean, yr)  | 35.79             | 33.78               | 33.39         | 34.38 |
| Birth order (mean)       | 1.66              | 1.47                | 1.34          | 1.50 |
| Nationality Dutch ($n$)  | 65 (95.6%)        | 63 (95.5%)          | 54 (91.5%)    | 182 (94.3%) |
| Educational level ($n$)  |                   |                     |               |        |
| Low                      | 14 (20.6%)        | 15 (22.7%)          | 16 (27.1%)    | 45 (23.3%) |
| Medium                   | 14 (20.6%)        | 15 (22.7%)          | 19 (32.2%)    | 48 (24.9%) |
| High                     | 40 (58.8%)        | 32 (48.5%)          | 16 (27.1%)    | 88 (45.6%) |
| Unknown                  | 0 (0%)            | 4 (6.1%)            | 8 (13.6%)     | 12 (6.2%) |
| **Marital status ($n$)** |                   |                     |               |        |
| Married /Reg. partners   | 43 (62.3%)        | 39 (57.4%)          | 31 (49.2%)    | 113 (56.5%) |
| Cohabiting               | 25 (36.2%)        | 26 (38.2%)          | 24 (38.1%)    | 75 (37.5%) |
| Single / Divorced        | 1 (1.5%)          | 1 (1.5%)            | 5 (7.9%)      | 7 (3.5%) |
| Unknown                  | 0 (0%)            | 2 (2.9%)            | 3 (4.8%)      | 5 (2.5%) |
Repeatedly Measured Multiple Group Data on PRAM-SBD Scores

Figures 1 and 2 show, respectively, mothers’ and fathers’ maximum likelihood estimates (MLE) of PRAM Self-Baby-Distance (PRAM-SBD) scores for full-term, moderately premature and very premature infants. PRAM-SBD scores were collected repeatedly over time: a baseline assessment (T0) 1 day after birth, and follow-up measurements at 1 week (T1) and 1 month (T2) postpartum.

**Figure 1.** MLE of PRAM-SBD scores (means and standard errors in millimeters) in mothers (n = 200) of full-term (n = 69), moderately preterm (n = 68), and very preterm infants (n = 63); assessed 1 day, 1 week and 1 month postpartum.

![Figure 1](image.png)

*Note: lower scores reflect parental bonding (closeness); higher scores reflect bonding difficulties (distance).*

**Figure 2.** MLE of PRAM-SBD scores (means and standard errors in millimeters) in fathers (n = 193) of full-term (n = 68), moderately preterm (n = 66), and very preterm infants (n = 59); assessed 1 day, 1 week and 1 month postpartum.

![Figure 2](image.png)

*Note: lower scores reflect parental bonding (closeness); higher scores reflect bonding difficulties (distance).*

Table 2 summarizes the results of statistical tests of the null hypothesis that mean...
PRAM-SBD scores do not change over time, which corresponds to a flat/horizontal time profile. Chi-square tests with 2 degrees of freedom were carried out separately for mothers and fathers, as well as for the three groups of infants. For both mothers and fathers, the three groups did not differ from each other on PRAM-SBD scores at the first measurement (T0) (see table 3). For full-term infants, neither mothers nor fathers showed a significant change in PRAM-SBD scores over time, whereas for moderately preterm infants a significant decrease only in the mother’s PRAM-SBD scores was observed during the first month postpartum (see figure 1). In addition, both mothers and fathers of very premature infants showed a significant decrease in PRAM-SBD scores during the first month after birth (see figures 1 and 2).

Table 3 displays the statistical test results of the null hypothesis of no group differences on PRAM-SBD scores at the three time points. One day after birth (T0), no effect of prematurity was found. However, 1 week (T1) and 1 month (T2) postpartum, the groups differed significantly from each other concerning PRAM-SBD outcomes. It was found that mothers of moderately premature and mothers of very premature infants on average had lower PRAM-SBD scores than mothers of full-term infants at 1 week (T1) and 1 month postpartum (T2). Fathers of moderately premature infants did not differ from fathers of full-term infants regarding PRAM-SBD scores. Yet, fathers of very premature infants on average had lower PRAM-SBD scores compared to fathers of full-terms at 1 week (T1) and 1 month postpartum (T2).

Table 2. Longitudinal model for change over time in PRAM-SBD scores in mothers (n = 200) and fathers (n = 193) of full-term, moderately preterm, and very preterm infants (Significance tests for hypothesis of no difference between time points (df = 2))

| Group         | Mothers |         | Fathers |         |
|---------------|---------|---------|---------|---------|
|               | CMIN    | P       | CMIN    | P       |
| Full term     | 1.72    | .424    | .73     | .694    |
| Moderately preterm | **10.61** | **.005** | 3.38    | .185    |
| Very preterm  | **17.25** | <.001   | **17.26** | <.001   |

Note: significant change over time is bolded for readability.
The impact of premature childbirth on parental bonding

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Table 3. Differences between full-term – moderately preterm infants, and full-term – very preterm infants, on mothers’ and fathers’ PRAM-SBD scores at three measurement occasions (Significance tests for hypothesis of no difference between full-term infants and preterm infants ($df = 1$))

| Occasion          | Mothers          | Fathers          |
|-------------------|------------------|------------------|
|                   | Full-terms vs    | Full-terms vs    | Full-terms vs    | Full-terms vs    |
|                   | Moderately       | Very preterms    | Moderately       | Very preterms    |
|                   | CMIN             | P                | CMIN             | P                | CMIN             | P                |
| T0 1 day          | .00              | .997             | .021             | .884             | .92              | .338             | .50              | .481             |
| postpartum        |                  |                  |                  |                  |                  |                  |                  |
| T1 1 week         | **4.37**         | **.037**         | **4.27**         | **.039**         | .68              | .409             | **9.47**         | **.002**         |
| postpartum        |                  |                  |                  |                  |                  |                  |                  |                  |
| T2 1 month        | **4.72**         | **.030**         | **8.99**         | **.003**         | 1.54             | .215             | **7.38**         | **.007**         |
| postpartum        |                  |                  |                  |                  |                  |                  |                  |                  |

Note: significant differences are bolded for readability.

Differences Between Mothers and Fathers on PRAM-SBD Scores

Table 4 summarizes the results of the tests of the null hypothesis that mothers and fathers do not differ in bonding with their newborn. Chi-square tests with 1 degree of freedom were carried out separately for the three infant groups and measurement occasions. For full-term as well as moderately premature infants, clear significant differences between mothers’ and fathers’ PRAM-SBD scores were observed at one week (T1) and one month (T2) after birth, with lower PRAM-SBD scores for mothers; while at baseline (T0) these groups did not differ from each other regarding PRAM outcomes. For very premature infants, lower PRAM-SBD scores were found for mothers compared to fathers at 1 day (T0) and 1 month (T2) after birth, but differences between parents were small and marginally significant. There were no differences in PRAM scores between mothers and fathers of very preterm infants 1 week postpartum (T1).

Table 4. Differences between mothers and fathers on PRAM-SBD scores at three measurement occasions for full-term, moderately preterm and very preterm infants (Significance tests for hypothesis of no difference between mother and father ($df = 1$))

| Group             | 1 Day Postpartum | 1 Week Postpartum | 1 Month Postpartum |
|-------------------|------------------|-------------------|--------------------|
|                   | CMIN             | P                 | CMIN               | P                 | CMIN              | P                 |
| Full terms        | 2.16             | .141              | **8.45**           | **.004**          | **6.85**          | **.009**          |
| Moderately        | 2.93             | .087              | **14.62**          | <.001             | **12.65**         | <.001             |
| preterms          | **3.96**         | **.047**          | .69                | .408              | **4.72**          | **.030**          |
| Very preterms     |                  |                   |                    |                   |                   |                   |

Note: significant differences are bolded for readability.
The impact of premature childbirth on parental bonding

Data on Mothers’ and Fathers’ PBQ Impaired Bonding Scores

To determine the convergent validity between PRAM-SBD and PBQ “impaired bonding” subscale scores, Pearson product-moment correlations were computed. The two measures were positively correlated in both mothers \( r(174) = .31, p < .001 \), and fathers \( r(164) = .42, p < .001 \). The strength of the association between the PRAM and PBQ subscale “impaired bonding” is moderate, but the correlation coefficient is highly significant.

Figures 3 displays, respectively, mothers’ and fathers’ PBQ “impaired bonding” subscale scores 1 month postpartum, for full-term, moderately premature and very premature infants. One-way ANOVAs revealed significant differences at the \( p < .05 \) level in parental bonding between the three groups under study, for both mothers \( F(2, 174) = 9.43, p < .001 \), and fathers \( F(2, 161) = 7.24, p = .001 \). Post hoc comparisons using the Bonferroni correction revealed that mothers of moderately premature \( (p = .002) \) and very premature \( (p < .001) \) infants on average reported less bonding problems with their infant, compared with mothers of full-term infants. In fathers, only a difference between the full-term and very preterm group was observed, with fathers of very preterm infants reporting less bonding problems than fathers of full-term infants \( (p = .001) \).

Figure 3. Mean scores of the Postpartum Bonding Questionnaire (PBQ), for the subscale “Impaired Bonding,” assessed 1 month postpartum in mothers \( (n = 177) \) of full-term \( (n = 64) \), moderately preterm \( (n = 61) \) and very preterm infants \( (n = 52) \); and in fathers \( (n = 164) \) of full-term \( (n = 61) \), moderately preterm \( (n = 54) \) and very preterm infants \( (n = 49) \).

Note: higher scores reflect more bonding problems (impaired bonding).

Discussion

The aims of the present study were twofold: (1) to examine feelings of bonding in a sample of parents of full-term, moderately premature, and very premature infants on three occasions after birth, and (2) to assess differences in bonding representations between mothers and fathers of full-term and preterm infants in the postnatal period.

It was found that 1 day postpartum, the three groups under study did not differ from each other on PRAM-SBD scores, reflecting their degree of parental bonding. In the case of
full-term infants, there were no clear variations in the scores of either fathers or mothers during the neonatal period. However, after moderately preterm delivery, PRAM-SBD scores in mothers decreased during the first month postpartum, whereas after very preterm delivery, decreases in PRAM-SBD occurred in both mothers and fathers. Since lower PRAM-SBD scores represent stronger feelings of parent-infant connectedness (Van Bakel et al., 2009), these findings suggest a higher degree of parent-infant bonding after premature childbirth. Moreover, the bonding measure PBQ (i.e. the subscale “impaired bonding”) revealed similar results. Results of the PBQ analysis were thus in line with PRAM findings 1 month postpartum, as mothers of moderately preterm infants and mothers of very preterm infants, as well as fathers of very preterm infants, on average reported less bonding problems compared to parents of full-term infants.

Findings of previous studies concerning parental bonding and investment were contradictory and inconclusive concerning the impact of preterm birth on the parent-infant relationship. It has been reported in some studies that, despite the initial roller coaster of negative emotions, most parents are immediately involved with and committed to their preterm infant, whereas other studies demonstrated that parents experience persistent difficulties in bonding with their premature newborn (Goldberg and DiVitto, 2002; Muller-Nix and Ansermet, 2009). From evolutionary theory it can be derived that the most important factor influencing parental investment in a premature infant is parents’ access to care giving resources (Mann, 1992; Bugental et al., 2012). The results of our study seem to support the notion that in affluent countries with adequate resources, parental bonding and investment in preterm infants, on average, may be higher than in full-term infants.

A possible explanation for the above-mentioned findings is offered by the theory of compensatory care (Beckwith and Cohen, 1978). This theory predicts that there is increased parental care giving behavior to sick and high-risk infants in order to attenuate the effects of hazardous events. Some studies have already reported that prematurity actually may stimulate more parental care and investment instead of disinterest and non-attachment (Beckwith and Cohen, 1978; Wright and Zucker, 1980). Therefore, increased nurturing and caring behavior has been proposed as a compensatory homeostatic mechanism after premature childbirth (Beckwith and Cohen, 1978). High levels of parental bonding and care after preterm childbirth could be beneficial for the infant, since the quality of the early parent-infant relationship is considered to be an important mediating factor between the infant’s perinatal risk status and developmental outcome (Forcada-Guex et al., 2006; Singer et al., 2003). Alternatively, compensatory care for preterm infants could also result from cognitive dissonance in parents (Festinger, 1957). As it is psychologically uncomfortable to hold conflicting cognitions, it could be argued that parents may feel a closer bond just because they invested so much (in terms of time, money and energy) in their preterm hospitalized infant.

Our findings could also be the consequence of other psychological processes underlying the bond formation between parents and their premature infant. For instance, premature childbirth can be a very stressful, emotionally demanding and traumatic event for parents, inducing feelings of anxiety, helplessness, depression, and anger (Muller-Nix and Ansermet, 2009). These emotions, as painful as they may be, are important to help parents find some meaning in the situation, and to become aware of their own new
The impact of premature childbirth on parental bonding

parenthood with the reality of having a premature infant (Pancer, Pratt, Hunsberger, and Gallant, 2000). Borghini et al. (2006) showed that parents of high-risk premature infants, who were emotionally affected, anxious and worried during their infant’s hospitalization, in particular developed a strong bond with their infant at 6 and 18 month follow-up assessments, whereas withdrawal of parental emotions led to difficulties in establishing a close parent-infant relationship and emotional detachment. These authors argue that parental emotional arousal during hospital stay may facilitate parental involvement, even though the risk of developing distorted representations towards their infant is also increased.

Alternatively, it could be speculated that the decrease in PRAM-SBD scores during the first month postpartum reflects a more stimulating parenting style that is often observed in parents of premature infants (Feldman and Eidelman, 2007; Muller-Nix and Ansermet, 2009; Muller-Nix et al., 2004). Since premature infants typically are less alert, less active and less responsive than full-terms in the first months after birth, their mothers may tend to engage in more active mothering as a result (Muller-Nix and Ansermet, 2009). Small PRAM-SBD scores, with minimal distance between the “self-circle” and the “baby-circle,” could reflect this stimulating, controlling, or even intrusive parenting after premature childbirth.

PRAM-SBD scores could also theoretically relate to the underlying principle of the original instrument PRISM (Buchi et al., 1998), in which distance-scores indicate the perceived burden, degree of suffering, and impact of an illness on a person. PRISM distance-measure symbolizes a person’s perception of the intrusiveness, unpredictability and controllability of the illness or its symptoms, as well as potential interference with important aspects of daily life (Buchi et al., 1998; Buchi et al., 2002), an adequate description of the way parents can experience an infant’s preterm birth and consequent period of hospitalization. In addition, parallels can be drawn between the PRAM and an adapted version of PRISM used by Büchi et al. (2009) in a study about long-term grief experience among couples to assess parental suffering due to loss of their premature baby.

The secondary aim of the study was to examine differences in bonding between mothers and fathers in the three groups under study. It was anticipated that fathers of preterm infants would show relatively high levels of bonding. One day postpartum, similar levels of bonding were observed for mothers and fathers of full-term and moderately preterm infants. However, 1 week and 1 month postpartum, lower PRAM-SBD-scores were found for the mothers compared to fathers in these groups, suggesting a higher degree of bonding in mothers during the first weeks after childbirth. These gender differences on PRAM-SBD were previously reported by Van Bakel et al. (2009) in a prenatal study. In contrast, in the very premature group, differences in bonding between mothers and fathers were extremely small, and not existing even at 1 week postpartum. This finding corroborates previous studies which demonstrated that fathers of high-risk preterm infants in the first months postpartum were more involved with their infant in comparison with fathers of full-terms (Brown et al., 1991; Harrison, 1990). Enhanced paternal bonding after preterm childbirth could be explained by the fact that fathers of premature infants have a unique and demanding supporting role during hospitalization of the infant. In addition, nursing of the infant in an incubator can be done by either the mother or father.
The impact of premature childbirth on parental bonding

A limitation of the present study is the self-report basis of the measurement instruments, especially concerning the PBQ, in which the possibility of a social desirability bias is present. In the case that parents would experience difficulties with their infant, anxiety about social youth services might lead them to under-report bonding-problems. Furthermore, the fact that there is no “golden standard” to measure the complex and multifaceted concept of parental bonding might be considered a drawback. To overcome this limitation we included two different bonding instruments in our study, the PRAM and the PBQ, with both measures yielding comparable results. However, the question remains if these outcomes solely represent the strength of the bond between parent and infant, or if they also reflect alternative constructs, such as parental emotional arousal, the intrusiveness of the premature infant in daily life, or even suffering in parents of premature infants. Possibly the bonding measures are sensitive to a combination of these concepts in our study population. In addition, low PRAM-SBD scores could represent the desire of parents to be close to their infant, particularly in the stressful situation of hospitalization when they cannot physically be present all the time. Maybe a parent’s suffering and emotional arousal are directly proportional to the strength of the parent-infant attachment relation, in a similar way as sadness and love are mutually connected. Moreover, it is possible that for parents of hospitalized premature infants it is necessary to be totally preoccupied and involved with their infant in order to protect and soothe their child, provide compensatory care, think about his or her future, and in that way establishing a close relationship with their infant. Hence in parents of prematures, (temporarily) reduced PRAM-SBD scores, representing a higher degree of parent-infant bonding, could reflect this attempt to attenuate the adverse effects of premature childbirth and promote the development of an affectionate parent-infant bond.

To summarize, this study provides some first insights into the process of bonding development in mothers and fathers of full-term and preterm infants. Specific characteristic patterns were found for both parents, dependent on the status of the baby. Results seems to support the notion that bonding is not a fixed given, but rather a process with its own dynamics, which seems to be influenced by child characteristics after the first exposure. Our findings strongly challenge the view that prematurity may inhibit the normal bonding process. It certainly seems to affect this process, but rather than impeding or inhibiting it, bonding seems to be stimulated, at least in an affluent country such as the Netherlands. However, broad generalizations from this Dutch sample cannot be made, as parental bonding and subsequent investment are very much dependent on circumstances and resources. Future studies with different populations, as well as later follow-up measurements, are needed to clarify the development and process of parent-infant bonding after premature childbirth.

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The impact of premature childbirth on parental bonding

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