



# Is level of prematurity a risk/plasticity factor at three years of age?



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## ABSTRACT

Children born preterm have poorer outcomes than children born full-term, but the caregiving environment can ameliorate some of these differences. Recent research has proposed that preterm birth may be a plasticity factor, leading to better outcomes for preterm than full-term infants in higher quality environments. This analysis uses data from two waves of an Irish study of children (at 9 months and 3 years of age,  $n = 11,134$  children) and their caregivers ( $n = 11,132$  mothers,  $n = 9998$  fathers) to investigate differences in how caregiving affects social, cognitive, and motor skills between full-term, late preterm, and very preterm children. Results indicate that parental emotional distress and quality of attachment are important for child outcomes. Both being born very preterm and late preterm continue to be risk factors for poorer outcomes at 3 years of age. Only fathers' emotional distress significantly moderated the effect of prematurity on infants' cognitive and social outcomes—no other interactions between prematurity and environment were significant. These interactions were somewhat in line with diathesis stress, but the effect sizes were too small to provide strong support for this model. There is no evidence that preterm birth is a plasticity factor.

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## 1. Introduction

Preterm birth ( $\leq 36$  weeks gestation) is a growing public health concern, accounting for more than 11% of live births worldwide (Blencowe et al., 2012) and for 6% of live births in Ireland (Economic and Social Research Institute, 2013). While there are different definitions, level of prematurity is often split into three categories: very preterm ( $\leq 33$  weeks), late preterm (34–36 weeks) and full-term ( $\geq 37$  weeks), with children born earlier tending to have less positive developmental outcomes (National Institute of Child Health and Human Development [NICHD], 2014; Saigal & Doyle, 2008; Sullivan & Hawes, 2007). Preterm children have a greater frequency of behavioural issues (Anderson, Doyle, & The Victorian Infant Collaborative Study Group, 2003; Delobel-Ayoub et al., 2009), poorer performance on cognitive assessments (Anderson et al., 2003; Baron et al., 2014; Ionio et al., 2016), and a greater likelihood of fine and gross motor skill impairment (Baron et al., 2014; Foulder-Hughes & Cooke, 2003; Sullivan & Hawes, 2007). These effects continue into adolescence (de Kieviet, Piek, Aarnoudse-Moens, & Oosterlaan, 2009; Gardner et al., 2004; Johnson, 2007).

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Because of the well-documented adverse consequences associated with preterm birth (Cheong et al., 2017; NICHD, 2014; Saigal & Doyle, 2008), it has typically been characterized as a vulnerability factor. In other words, preterm birth makes one more likely to be adversely affected by environmental stressors (Belsky & Pluess, 2009). However, recent research has suggested that preterm birth may, instead, be a plasticity factor (e.g. Gueron-Sela, Atzaba-Poria, Meiri, & Marks, 2015; Shah, Robbins, Coelho, & Poehlmann, 2013)—that is, a factor that makes one more sensitive to both negative and positive environmental influences (Belsky & Pluess, 2009).

If preterm birth acts as a continuing plasticity factor into toddlerhood, this would have important implications for interventions aiming to improve developmental functioning of preterm infants. Given the growing numbers of preterm births and the lack of consensus in the literature, it is critical to examine this area further. The current analysis used data from a nationally representative study of infants and their families (Growing Up in Ireland, GUI), to test whether the effects of mothers' and fathers' emotional distress and quality of attachment on child outcomes differed by level of prematurity. We hypothesized that early and late preterm status would be associated with less positive social, cognitive, and motor skills outcomes, but did not make a prediction of whether prematurity was a risk or plasticity factor.

### 1.1. Parenting of preterm infants

Parenting influences emotional, social, and linguistic development (e.g. Landry, Smith, & Swank, 2003; Shah et al., 2013) as well as executive function (Bernier, Carlson, & Whipple, 2010), and academic achievement (Steinberg, 2001). Preterm birth tends to have a negative psychosocial and emotional effect on families, which may impact the caregiving environments where preterm children are raised (Saigal & Doyle, 2008, although see Bilgin & Wolke, 2015). It may disrupt normal parental roles, cause emotional distress, and lead to an altered parent–child relationship (Miles & Holditch-Davis, 1997). Two aspects of the parent–preterm infant relationship that are likely to affect infant wellbeing are parent–infant attachment and parent stress.

Parental attachment is an aspect of parents' emotional bonds with their infants and is strongly related to the quality of the parent–infant relationship (Slade, Belsky, Aber, & Phelps, 1999). Compared to full-term infants, preterm infants and their mothers have higher rates of insecure attachment during the first twelve months after birth (Korja, Latva, & Lehtonen, 2012), particularly when infants have severe perinatal risks (Borghini et al., 2006). Parent–child attachment may influence child outcomes by compromising the affective communication system, providing fewer opportunities for a child to engage in positive social and learning interactions with their parents, and affecting how children organize their behaviour towards others (Ainsworth, 1979; Tronick, 1989). Similarly, parents of preterm children have higher levels of stress and depression than parents of full-term children (Sansavini et al., 2015; Treyvaud, 2014). There is an association between gestational age and stress even within preterm infants, where mothers and fathers of children born earlier experience greater stress (Schappin, Wijnroks, Uniken Venema, & Jongmans, 2013). Parents who are highly emotionally distressed are less sensitive, less affirming, and more negating of their infants (Murray, Fiori-Cowley, Hooper, & Cooper, 1996), all of which affect a child's functioning. Some well-established differences in outcomes between preterm and full-term infants may be related to such differences in caregiving environments.

### 1.2. Effects of parenting on preterm infants' social, cognitive, and motor skills

There are two primary theories of how environmental factors – such as parenting – may affect developmental outcomes: diathesis stress and differential susceptibility. Both models posit an interaction between preterm birth and environment, but differ in their predictions for the nature of that interaction. The diathesis stress model (Monroe & Cummins, 2015; Monroe & Simons, 1991) proposes that children born with vulnerabilities are *more susceptible to negative* environmental influences than children who were not born with those vulnerabilities. The diathesis stress model predicts that when faced with a similarly adverse environment, preterm children will have fewer positive outcomes than full-term children, because their prematurity acts as a diathesis. By contrast, the differential susceptibility model (Bakermans-Kranenburg & Van IJzendoorn, 2015; Belsky, Bakermans-Kranenburg, & van IJzendoorn, 2007) suggests that some aspects have been incorrectly characterized as vulnerabilities when they are actually plasticity factors, making children *more susceptible to either negative or positive* environmental influences. The differential susceptibility model would predict that preterm children are more vulnerable to adverse environments than full-term children, but that they may also experience greater benefit from positive environments than full-term children. Preterm birth may act as a plasticity factor due to cerebral structural abnormalities such as reduced volume of cortical and deep nuclear gray matter (Inder, Warfield, Wang, Hüppi, & Volpe, 2005). Preterm infants might depend more on their environment to regulate behaviour because of this neurobiological variation, which may lead to better functioning for preterm infants exposed to high quality parental environments.

Research examining the interaction between caregiving and gestational age has produced mixed findings as to whether effects on social outcomes are best explained by differential susceptibility or diathesis stress. Gueron-Sela et al.'s (2015) study comparing infants born between 28 and 33 weeks gestation and full-term infants showed that preterm infants exposed to higher levels of maternal distress or low quality triadic family interactions demonstrated lower social competence than full-term infants at 12 months of age, while those exposed to low maternal distress or high quality family interactions outperformed the full-term infants on measures of social competence. Because biological risk factors affect social abilities to a smaller degree than cognitive abilities (Bendersky & Lewis, 1994), the social abilities of children born preterm may have

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