

Exploring Links Among Early Adversity, Temperament, and Social Relationships

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Dedication

For Alex and Alyssa

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Abstract

A range of early adversities put children at risk for social difficulties, but the mechanisms through which preterm birth specifically is linked to social problems are not well understood. Biopsychosocial frameworks suggest that both external (i.e., family environment) and internal (i.e., child characteristics) factors interact with the developing brain to shape social outcomes. To explore mechanisms underlying the association between preterm birth and social problems, this dissertation includes three manuscripts that longitudinally explore internal and external predictors of social development outcomes in preterm and term children from childhood to early adulthood.

The first manuscript compared the impact of VP birth/very low birthweight (VP/VLBW; < 32 weeks' gestation or < 1,500 grams) and extended institutional deprivation (> 6 months of severely depriving institutional rearing) on temperament across five dimensions at 6 years of age, by comparing 299 VP/VLBW children to 311 healthy term controls, and 101 post-institutionalized children to 52 non-deprived adoptees. Results showed that VP/VLBW and post-institutionalized children had similarly aberrant temperamental profiles in terms of lower effortful control, but different aberrant profiles in terms of higher activity (post-institutionalized only) and lower shyness (VP/VLBW only).

The second manuscript explored whether parent-infant relationships and child temperament mediated a developmental cascade from preterm birth to poorer friendships. Path analyses were conducted for 1,181 children born across the whole gestational age range. Results showed evidence of cascading effects from gestational age to parent-infant relationships, to inhibitory control, and to social inhibition, which partially explained differences in friendships at 8 years.

The third manuscript explored peer relationship trajectories of VP/VLBW and term-born individuals from childhood to early adulthood. Based on parent and self-reports at 6, 8, 13, and 26 years of age, peer acceptance, friendships, and peer problems trajectories were identified using latent profile analyses. Higher cognitive abilities at 20 months of age predicted more optimal trajectories in all peer relationship domains. Good parent-infant relationships at 5 months predicted lower peer problems trajectories. Early predictors differed for the VP/VLBW and term-born samples.

Implications regarding mechanisms linking preterm birth and long-term socialization are discussed across each manuscript.

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Chapter 1:

Introduction

Social relationships are foundational to healthy human development. From the earliest weeks of life, newborns show rudimentary social interaction skills, such as orienting to human faces (Valenza, Simion, Cassia, & Umiltà, 1996) and a preference for stimuli that signal readiness to interact, such as infant-directed speech, direct gaze, and happy expressions (Farroni et al., 2013; Leppänen & Nelson, 2009; Simion, Di Giorgio, Leo, & Bardi, 2011). Infants continue to develop these social interaction skills in the context of sustained caregiving relationships, which, optimally, provide consistent patterns of orchestrated exchanges (e.g., immediate and reliable soothing behaviors in response an infant's cry). Such exchanges deliver reassurance and cues about the world (Feldman, 2012a), forming a secure base from which to explore and engage in other relationships (Waters & Cummings, 2000). Moreover, the responsive exchanges that characterize sustained caregiving relationships promote the biobehavioral regulation necessary for individuals to eventually coordinate effective interaction and affiliative behavior with other social partners (Feldman, 2012b; Feldman, Gordon, Infuls, Gutbir, & Ebstein, 2013), such as same-aged peers. The dynamics of peer relationships and friendships change over the lifespan, with peers becoming even more important in late childhood and adolescence (Allen, Moore, Kuperminc, & Bell, 1998; Bohlin, Hagekull, & Andersson, 2005), but early success in peer relationships predicts better social adjustment (e.g., self-worth, school/job performance, romantic relationships) into adulthood (Bagwell, Newcomb, & Bukowski, 1998). Positive peer relationships also have other benefits, such as easing transitions and developmental challenges, throughout childhood and adulthood (Hartup & Stevens, 1999).

Early adverse experiences may disrupt the typical development of social relationships. Although it has been well-documented that severe early social and cognitive neglect confers risk for abnormal social development, including poorer social competence and more peer problems

(Gunnar & Van Dulmen, 2007; Kreppner, O'Connor, Dunn, & Andersen-Wood, 1999; Palacios, Moreno, & Román, 2013; Sonuga-Barke, Schlotz, & Kreppner, 2010; Tarullo, Bruce, & Gunnar, 2007), other types of early adversity, including preterm birth (< 37 weeks' gestation), have also been associated with a notably similar phenotype of social difficulties (Delobel-Ayoub et al., 2006; Reyes, Jaekel, & Wolke, 2019; Williamson & Jakobson, 2014; Wolke, Baumann, Strauss, Johnson, & Marlow, 2015) that are less understood. Signs of social interaction difficulties in preterm infants present as early as the first year of life (Landry, 1995). In childhood, very preterm individuals have less positive social engagement with peers (Ritchie, Bora, & Woodward, 2015), fewer friends and lower rates of peer acceptance (Heuser, Jaekel, & Wolke, 2017), and more peer problems than term-born comparisons (Bora, Pritchard, Moor, Austin, & Woodward, 2011; Delobel-Ayoub et al., 2006). These difficulties appear to be long-lasting, as extremely preterm individuals continue to be at risk for social withdrawal and more peer problems into adolescence and young adulthood (Eryigit-Madzwamuse, Strauss, Baumann, Bartmann, & Wolke, 2015; Linsell et al., 2018; Schmidt, Miskovic, Boyle, & Saigal, 2008). Comparing if preterm birth affects child characteristics in similar or different ways than other adversities, such as severe neglect, may shed light on whether such experiences share a similar neurodevelopmental pathway to poorer social outcomes, thus helping explain the link between preterm birth and life-long social difficulties.

Preterm Birth as a Marker of Early Adversity

About 60-75% of preterm births follow spontaneous preterm labor with unclear causes, while the remained or cases (25-40%) are the result of induction or pre-labor cesarean section due to fetal or maternal indication (Goldenberg, Culhane, Iams, & Romero, 2008). Risk factors associated with preterm birth include maternal stress, social adversity, Black ethnicity,

infection/inflammation, and preconception/prenatal smoking (Goldenberg et al., 2008). Preterm birth can also be related to clinician decisions to deliver early, for example, due to multiple fetuses after fertility treatment in often more socially advantaged women (Chawanpaiboon et al., 2019). However, the mechanisms linking these factors to birth outcomes are not clear, and up to 78% of the variance in the risk of preterm birth remains unexplained (Goldenberg et al., 2008; Raisanen, Gissler, Saari, Kramer, & Heinonen, 2013).

Across the whole gestational age range, the risk of neonatal mortality and morbidity is highest for very preterm (VP; <32 weeks gestation) births, but there is relative risk for moderately to late preterm (32-36 weeks gestation) births, and (to a much lesser extent) for early term (37-38 weeks gestation) births, compared to full-term (39-41 weeks gestation) births (Lumley, 1993; Tucker et al., 1991). Preterm neonates often suffer from immaturity of organs and superimposed complications (Volpe, 2009). Adverse conditions continue after birth and include exposure to pain and stress due to medical treatment (Grunau, 2013) and restricted interactions with caregivers during the first weeks to months of life (Milgrom et al., 2010). As a consequence, preterm children are at risk for various neurodevelopmental problems (Cheong et al., 2017), with the risk being greatest for those born with lowest gestational age (Linsell, Malouf, Morris, Kurinczuk, & Marlow, 2015; Narberhaus et al., 2007).

Although significant improvements in medical care have resulted in increased survival of preterm infants over the past few decades (Anthony et al., 2004; Stoll et al., 2010), especially at younger gestational ages (Doyle & Victorian Infant Collaborative Study Group, 2004), the long-term outcomes seem to persist even across cohorts from different countries and eras (e.g., Wolke et al., 2015; Wolke et al., 2019). Children born preterm suffer from increased vulnerability to problems across cognitive, emotional, social and behavioral domains (Potijk, Winter, Bos,

Kerstjens, & Reijneveld, 2015; Wolke et al., 2015; Woodward et al., 2009). It is thought that both biological vulnerability (e.g., brain injuries) and early environmental adversities (medical procedures that cause stress and limited contact with parents) contribute to the emergence of these problems (Montagna & Nosarti, 2016). Family-based interventions such as skin-to-skin contact (i.e., Kangaroo Care), single-family rooms in NICUs and parent education programs, which have become more common in recent decades, are associated with improved neonatal outcomes, including lower stress for infants and parents and shorter NICU hospitalizations (Lester et al., 2014; Melnyk et al. 2006; Mörelius, Örténstrand, Theodorsson, & Frostell, 2015), but the extent to which these early interventions impact long-term neurodevelopmental outcomes for preterm individuals is not yet clear.

External Factors as Potential Mechanisms

Biopsychosocial models of social development suggest that both external (e.g., family environment) and internal (e.g., individual characteristics) factors interact with brain development to shape social functioning (Beauchamp & Anderson, 2010). In particular, the quality of early caregiving experiences has received significant attention as an external factor that constitutes a potential pathway from early adversity to later social problems (Luecken et al., 2013). With regards to preterm birth more specifically, there is some evidence suggesting that parenting factors may contribute to poorer social outcomes (see Montagna & Nosarti, 2016 for a review). Parents of preterm infants have more psychological distress (Huhtala et al., 2012, 2014; Schappin, Wijnroks, Venema, & Jongmans, 2013) and symptoms of mental health problems (Kersting et al., 2004; Silverstein, Feinberg, Young, & Sauder, 2010; Vigod, Villegas, Dennis, & Ross, 2010), which may hinder optimal caregiving behaviors (Treyvaud, 2014), even years after the birth of their preterm infant (Treyvaud, Lee, Doyle, & Anderson, 2014). Moreover, preterm

children are more vulnerable to the negative effects of poor parenting (Jaekel, Pluess, Belsky, & Wolke, 2015), although they may also be more susceptible to the effects of positive parenting (Nichols, Jaekel, Bartmann, & Wolke, 2019; Poehlmann, Hane, Burnson, Maleck, Hamburger, & Shah, 2012). Studies of very preterm individuals have shown that better maternal mental health, lower intrusivity, and lower distress are associated with children's better social skills and socio-emotional regulation (Gray, Indurkha, & McCormick, 2004; Jones, Champion, & Woodward, 2013; Treyvaud et al., 2009; Treyvaud et al., 2012).

Importantly, however, it has been noted that parenting is not only a function of parental characteristics but instead is actively influenced by each child's unique characteristics (Belsky, 1984; Neece, Green, & Baker, 2012). Thus, researchers have been cautious to not conclude a causal direction of the relationship between parenting and social outcomes, but rather suggest that child characteristics should be explored as potential influences on parenting strategies (Treyvaud, 2014). Consistent with this perspective, researchers have found that mothers of preterm children are not less sensitive than mothers of full-term children (Bilgin & Wolke, 2015), but instead adapt their parenting strategies to their child's cognitive status (Jaekel, Wolke, & Chernova, 2012). Thus, it is imperative to explore not only the external inputs children receive in the context of specific early adversities, but also their active contributions to their own social environments.

Internal Factors as Potential Mechanisms

A useful framework for exploring children's characteristics across various domains (i.e., their internal inputs) that may be associated with social problems following early adversity is the concept of temperament. Temperamental dispositions reflect variation in both reactivity and regulation that modulate the expression of traits such as sociability, shyness, and activity levels

(Buss & Plomin, 1984; Rothbart, 2007), which may underlie socialization problems.

Consistently, previous research suggest that children's temperament plays an important role in their socioemotional functioning (Eisenberg et al., 2001; Kochanska & Knaack, 2003) and constitutes a potential mechanism through which early adversity shapes long-term outcomes (Nigg, 2006).

Taken together, previous work highlights the need to disentangle the links between early adversity, external inputs, and internal inputs in order to understand why preterm children are at risk for persistent social problems. To fill this gap, the current dissertation explores these links across three studies that longitudinally explore preterm children's social development from childhood to early adulthood. The first aim was to explore the association between preterm birth and child temperament at six years of age by comparing it to that of a different well-studied early adversity: severe institutional deprivation. The second aim was to explore whether temperamental characteristics affected by preterm birth mediated a developmental cascade from preterm birth to poorer social relationship outcomes at eight years of age. The final aim was to describe the nature and course of preterm children's social relationship outcomes, by identifying peer relationship trajectories across different domains from childhood (i.e., 6 years of age) to early adulthood (i.e., 26 years of age), as well as early predictors of these trajectories. To accomplish these aims, different methodologies were employed in each study.

In the first study (Reyes, Jaekel, Kreppner, Wolke, & Sonuga-Barke, 2019), the effect of preterm birth and institutional deprivation on temperament was compared by harmonizing data across two longitudinal cohorts. Using data from the Bavarian Longitudinal Study, 299 children born very preterm (<32 weeks' gestation) or at very low birth weight (<1500g; VP/VLBW) were compared with 311 healthy term born controls. Using data from the English and Romanian

Adoptees Study, 101 children who had experienced > 6 months of deprivation in Romanian institutions were compared with 52 non-deprived adoptees. At 6 years, temperament was assessed in all children via parent reports across 5 dimensions: effortful control, activity, shyness, emotionality, and sociability. Results showed that VP/VLBW and post-institutionalized children had similarly aberrant temperamental profiles in terms of lower effortful control, but different aberrant profiles in terms of higher activity (post-institutionalized only) and lower shyness (VP/VLBW only) compared to respective controls (Reyes et al., 2019b).

In the second study (Reyes, Jaekel, Heuser, & Wolke, 2019), data from the Bavarian Longitudinal Study (BLS) was used to explore mechanisms underlying differences in friendships at 8 years of age. A path analysis was performed for 1,181 children across the entire gestational age to model cascades from gestational age, to early parent-infant relationship at 5 months, to inhibitory control at 20 months, to social inhibition at 6 years, and to friendship scores at 8 years. Results showed evidence of cascading effects from gestational age to parent-infant relationships, to inhibitory control, and to social inhibition that partially explained differences in friendships at 8 years (Reyes et al., 2019a).

In the third study (Reyes, Jaekel, Bartmann, & Wolke, 2020), data from 218 VP/VLBW and 220 healthy term-born (37-42 weeks gestation) BLS participants was used to explore social relationships from 6 to 26 years of age, across three domains: peer acceptance, friendships, and peer problems. Results showed that higher cognitive abilities at 20 months of age were associated with more optimal trajectories in all peer relationship domains. Additionally, good early parent-infant relationships at 5 months of age were associated with lower peer problems trajectories. Subgroup analyses showed that predictors differed for the VP/VLBW and term-born

samples, with cognitive abilities and parent-infant relationships appearing to contribute more to outcomes in the VP/VLBW sample (Reyes et al., 2020).

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Chapter 2:
**A Comparison of the Effects of Preterm Birth and Institutional Deprivation on Child
Temperament**

Chapter 2, in full, is the material as it appears in:

Reyes, L. M., Jaekel, J., Kreppner, J., Wolke, D., & Sonuga-Barke, E. (2019). A comparison of the effects of preterm birth and institutional deprivation on child temperament.

Development and Psychopathology. doi: 10.1017/S0954579419001457

The dissertation author was the primary investigator and author of this paper.

Abstract

Both preterm birth and early institutional deprivation are associated with neurodevelopmental impairment – with both shared and distinctive features. To explore shared underlying mechanisms, this study directly compared effects of these putative risk factors on temperament profiles in six-year-olds: Children born very preterm (<32 weeks gestation) or at very low birthweight (<1500g) from the Bavarian Longitudinal Study (n=299); and children who experienced > 6 months of deprivation in Romanian institutions from the English and Romanian Adoptees Study (n=101). The former were compared with 311 healthy term born controls and the latter with 52 non-deprived adoptees. At 6 years, temperament was assessed via parent reports across 5 dimensions: effortful control, activity, shyness, emotionality, and sociability. Very preterm/very low birthweight and post-institutionalized children showed similarly aberrant profiles in terms of lower effortful control (preterm = -0.50 [95% CI= -0.67 to -0.33]; post-institutionalized = -0.48 [-0.82 to -0.14]) compared to their respective controls. Additionally, post-institutionalized children showed higher activity, whereas very preterm/very low birthweight children showed lower shyness. Preterm birth and early institutionalization are similarly associated with poorer effortful control, which might contribute to long-term vulnerability. More research is needed to examine temperamental processes as common mediators of negative long-term outcomes following early adversity.

Chapter 3:
Developmental Cascades of Social Inhibition and Friendships in Preterm and Full-Term
Children

Chapter 3, in full, is the material as it appears in:

Reyes, L. M., Jaekel, J., Heuser, K. M., & Wolke, D. (2019). Developmental cascades of social inhibition and friendships in preterm and full-term children. *Infant and Child Development, 28*(6), e2165. doi: 10.1002/icd.2165

The dissertation author was the primary investigator and author of this paper.

Abstract

Friendships are crucial to children's socioemotional development and quality of life. Children born preterm (<37 weeks' gestation) have an increased risk for social relationship difficulties, including fewer friends, but the mechanisms underlying the link between lower gestational age and fewer friendships are not clear. The prospective Bavarian Longitudinal Study investigated potential cascading effects on N=1,181 children's friendships at 8 years. Path modeling indicated that higher gestational age predicted good early parent-infant relationship quality, good inhibitory control, and higher friendship scores. Good parent-infant relationship quality predicted good inhibitory control, which subsequently predicted low social inhibition at 6 years and higher friendship scores at 8 years. There is evidence of cascading effects from gestational age to early parent-infant relationships, to toddlers' inhibitory control, and to social inhibition, which partially explain differences in children's friendships at 8 years of age.

Chapter 4:
Peer Relationship Trajectories in Very Preterm and Term Individuals from Childhood to
Early Adulthood

Chapter 4, in full, is currently under submission for publication of the material as:

Reyes, L. M., Jaekel, J., Bartmann, P., & Wolke, D. Peer relationship trajectories in very preterm and term individuals from childhood to early adulthood.

The dissertation author was the primary investigator and author of this paper.

Abstract

Very preterm and very low birthweight (VP/VLBW; < 32 weeks gestation/ < 1,500 grams) children are at risk for social relationship difficulties, including fewer friendships, lower peer acceptance, and more peer problems at school-age and throughout adolescence. Adults born VP/VLBW also report more social problems, but the stability of difficulties in specific domains of social relationships across developmental periods has not been explored longitudinally. Moreover, VP/VLBW individuals are a heterogeneous group, but it is unknown what early factors predict peer relationship trajectories. Therefore, we used data from 218 VP/VLBW and 220 healthy term-born (37-42 weeks gestation) individuals who were followed prospectively from birth to early adulthood as part of the Bavarian Longitudinal Study. Parent and self-reports at 6, 8, 13, and 26 years were combined into comprehensive developmentally-appropriate scores across three domains: peer acceptance, friendships, and peer problems. Longitudinal latent profile analyses were used to identify trajectories in the full sample, and separately for VP/VLBW and term-born subgroups. Multinomial regressions showed that higher cognitive abilities at 20 months of age were associated with more optimal trajectories in all peer relationship domains. Additionally, good parent-infant relationships at 5 months of age were associated with lower peer problems trajectories. Subgroup analyses showed that significant predictors differed for the VP/VLBW and term-born samples. Findings suggest that early cognitive deficits may underlie persistent peer relationship difficulties in VP/VLBW samples. Positive parent-infant relationships may help reduce preterm children's risk for long-term peer problems.

Social relationships are central to human development across the lifespan. Peer acceptance and close dyadic friendships in childhood promote positive behavioral and emotional outcomes, such as higher classroom engagement and academic achievement (Buhs, Ladd, & Herald, 2006), lower levels of internalizing problems (La Greca & Harrison, 2005; Laursen, Bukowski, Aunola, & Nurmi, 2007), and protection from peer victimization (Sapouna & Wolke, 2013; Schwartz, Dodge, Pettit, Bates, & The Conduct Problems Prevention Research, 2000). Early success in peer relationships predicts better social adjustment in adulthood and throughout later life (Bagwell, Newcomb, & Bukowski, 1998; Ungar, Ghazinour, & Richter, 2013).

Developmental theories suggest that distinct domains of social relationships confer unique benefits that vary in importance as social needs change during different developmental periods (Sullivan, 1953). For instance, peer acceptance (i.e., high sociometric status/popularity), which refers to the degree to which individuals are liked by their peer group (Newcomb, Bukowski, & Pattee, 1993), is thought to be particularly important in middle childhood, as it affords opportunities for friendship formation and contributes to self-perceptions of interpersonal competence (Bukowski, Pizzamiglio, Newcomb, & Hoza, 1996; Nangle, Erdley, Newman, Mason, & Carpenter, 2003). Friendships, in contrast, are deep dyadic relationships characterized by their reciprocal nature, and provide companionship and emotional support, which are crucial for meeting adolescents' increasing need for intimacy (Buhrmester & Furman, 1986; Narr, Allen, Tan, & Loeb, 2017). Peer problems, on the other hand, more broadly encompass negative social experiences, such as being disliked or getting teased, which may, in some cases, be precipitated by behaviors that are inappropriate to the peer group (Bierman, Smoot, & Aumiller, 1993). In contrast to simply being neglected by the peer group, peer problems encompass the presence of conflict and hostility, or being actively rejected by peers (Wentzel & Asher, 1995). Successfully

resolving conflicts with peers is important for building life-long social skills, but consistent failure in these attempts is associated with enduring problematic social interactions into adulthood (Laursen, Finkelstein, & Betts, 2001; Wolke, Copeland, Angold, & Costello, 2013). Because these overlapping but distinct social relationships domains constitute unique influences on development (e.g., Bagwell et al., 1998; Nangle et al., 2003; Narr et al., 2019), researchers have emphasized the need for assessment methods that take into account the nature, quantity, and quality of peer relationships (e.g., Bukowski & Hoza, 1989) to more accurately reflect the complexities of individuals' social lives.

Preterm birth and peer relationships

Early adverse experiences, such as preterm birth, may disrupt the typical development of social relationships. Indeed, signs of social interaction difficulties in very preterm and/or very low birthweight (VP/VLBW; < 32 weeks gestation/ < 1,500 grams) infants present as early as the first year of life (Landry, 1995). In childhood, VP/VLBW individuals have fewer friends, lower rates of peer acceptance (Heuser, Jaekel, & Wolke, 2018), and more peer problems than full-term (39-41 weeks gestation) comparisons (Bora, Pritchard, Moor, Austin, & Woodward, 2011). The early onset of difficulties may exacerbate social problems over time due to their direct impacts on future relationships as well as constrained opportunities for learning new adaptive social skills (Jones, Champion, & Woodward, 2013). Indeed, early social difficulties appear to be long-lasting, as VP/VLBW individuals continue to be at risk for social withdrawal and peer problems into adolescence and young adulthood (Eryigit-Madzwamuse, Strauss, Baumann, Bartmann, & Wolke, 2015; Linsell, Johnson, Wolke, Morris, et al., 2018).

However, the course of social difficulties in preterm samples from childhood to adulthood remains unclear, especially regarding specific domains of peer relationships. For

instance, although a recent meta-analysis found that preterm young adults were less likely to have ever experienced a romantic relationship, sexual intercourse, or parenthood than term comparisons (Mendonça, Bilgin, & Wolke, 2019), no difference was found for perceptions of peer social support between both groups. Importantly, in this meta-analysis, the authors were unable to compare data on participants' number of friends, which has been shown to be lower for preterm children and adults in most studies (Baumann, Bartmann, & Wolke, 2016; Darlow, Horwood, Pere-Bracken, & Woodward, 2013; Heuser et al., 2018) compared to term comparisons. To make sense of these findings, the authors propose two explanations: It could be that despite fewer close relationships, when preterm adults have friends, their relationship quality is not poorer than for term comparisons; or that the quality of social relationships in preterm individuals improves into adulthood (Mendonça et al., 2019). These complexities highlight the need for studies that explore social outcomes of preterm birth longitudinally and that differentiate between domains of peer relationships, to better understand their potential differential impact on preterm individuals' life-long social adjustment.

Predictors of social outcomes

Identifying early predictors of distinct patterns of peer relationships can shed light on potential mechanisms leading from preterm birth to social difficulties, as well as informing avenues for early intervention. Current hypothetical models of preterm children's socio-emotional development have focused on both biological vulnerabilities (e.g., brain damage leading to general cognitive deficits) and environmental influences (e.g., parenting) as potential pathways to long-term social difficulties (Montagna & Nosarti, 2016). Indeed, preterm birth is a risk factor for cognitive impairments (Twilhaar et al., 2018), and there is a co-occurrence of cognitive and socio-emotional difficulties, both in the general population and in preterm samples

(Guralnick, Neville, Hammond, & Connor, 2007). However, whereas some studies showed that preterm children's more frequent cognitive deficits (e.g. lower IQ) predicted lower social competence at 4-years of age (Jones et al., 2013) and peer relationship difficulties in middle childhood (Heuser et al., 2018), others found that lower cognitive abilities were not associated with the characteristics thought to explain preterm adults' social difficulties (i.e., lower openness to experience, higher introversion and neuroticism; Eryigit-Madzwamuse et al., 2015).

With regards to parents' influence on social outcomes, research has shown that parents of preterm infants have more psychological distress (Huhtala et al., 2014; Schappin, Wijnroks, Venema, & Jongmans, 2013) and symptoms of mental health problems (Silverstein, Feinberg, Young, & Sauder, 2010), suggesting there could be vulnerability in their early parenting strategies even if symptoms decrease as the child overcomes medical risks (Treyvaud, 2014). Although, on average, mothers of preterm infants are no less sensitive than mothers of full-term controls, preterm infants have been shown to be more vulnerable to the effects of negative parenting (Jaekel, Pluess, Belsky, & Wolke, 2015). Conversely, positive parenting may constitute a protective factor for preterm children's outcomes (Wolke, Jaekel, Hall, & Baumann, 2013). Better maternal mental health, lower intrusiveness, and lower distress are associated with preterm children's better social skills and socio-emotional regulation (Jones et al., 2013; Treyvaud et al., 2009). However, since children's own characteristics also influence parenting behaviors and strategies (Belsky, 1984; Jaekel, Wolke, & Chernova, 2012) their individual differences should also be concurrently explored as potential predictors of social outcomes.

Furthermore, there is substantial unexplained heterogeneity in developmental outcomes within and across VP/VLBW samples (Johnson et al., 2018; Lean et al., 2019). Thus, factors such as children's individual variation in reactivity and regulation that have not been highlighted

in previous models of preterm children's social development (e.g., Montagna & Nosarti, 2016) deserve consideration, as they are known to impact social outcomes in the general population (Eisenberg et al., 2001). For instance, early inhibitory control – the ability to control behavioral impulses – has been positively associated with empathic and prosocial behaviors during preschoolers' peer interactions (Hughes, White, Sharpen, & Dunn, 2000). Conversely, poor inhibitory control of behavior (i.e., poor self-control; Diamond, 2013) appears to impair social interactions by failing to impede impulsive reactions, negative displays of emotions, and other antisocial behaviors (Hughes et al., 2000), which have been reported to contribute to peer rejection (Ladd & Troop-Gordon, 2003; Rotenberg, Michalik, Eisenberg, & Betts, 2008). For example, in a recent study of children born across the entire gestational age range, poor inhibitory control at 20 months predicted lower success in friendships at 8 years of age (Reyes, Jaekel, Heuser, & Wolke, 2019). Given that a substantial portion of VP/VLBW individuals display resilient neurodevelopmental profiles (Lean et al., 2019), whether good regulatory skills in early childhood may contribute to a more positive course of peer relationship outcomes in preterm samples should be explored.

The current study

The goals of the current study are to (1) characterize patterns of peer relationship trajectories in VP/VLBW and healthy term-born (37-42 weeks gestation) individuals from childhood to young adulthood across three domains (i.e., friends, peer acceptance, peer problems), and to (2) identify early predictors of those trajectories, including potential biological (i.e., cognitive vulnerability), environmental (i.e., parent-infant relationship), and individual (i.e., inhibitory control) factors. Since infant clinical characteristics and socio-demographic factors have also been shown to differentiate resilient from at-risk trajectories in neurodevelopmental

outcomes of preterm samples (Johnson et al., 2018; Lean et al., 2019), neonatal medical risk and family socio-economic status (SES) will be included as potential predictors in the analyses (Wolke, Johnson, & Mendonça, 2019). Additionally, because gender has been associated with differences in patterns of social interaction in the general population (Underwood, 2007), analyses will also include child sex. Given that trajectories within risk and control groups may differ (e.g., Johnson et al., 2018), and that predictors may operate differently in the risk and control groups, analyses will explore trajectories for the full sample (i.e., VP/VLBW and term group) combined, as well as separately for the VP/VLBW and term-born groups. Depending on the number of trajectories identified, multinomial or binary logistic regression will be used to test predictors of membership in each trajectory profile. Consistent with the literature, it is hypothesized that VP/VLBW birth will predict suboptimal peer relationship trajectories across all domains. In line with the biological and environmental models of preterm individuals' social development (Montagna & Nosarti, 2016), it is hypothesized that better cognitive abilities and good parent-infant relationships will be associated with more optimal peer relationships trajectories in VP/VLBW individuals, whereas good inhibitory control will be associated with optimal trajectories in both the term-born and VP/VLBW samples.

Method

Design

The Bavarian Longitudinal Study is a prospective, whole-population, geographically-defined study that followed VP/VLBW children born in Southern Bavaria (Germany) in 1985-1986 who required admission to one of 16 children's hospitals within the first 10 days after birth. During the same period, healthy term-born comparisons (37-42 weeks gestation) were recruited in obstetric units in the same area. Full details of this sample are provided elsewhere (Baumann

et al., 2016; Eryigit Madzwamuse, Baumann, Jaekel, Bartmann, & Wolke, 2015). The current study is based on data collected from birth until 26 years of age. Ethical approval was obtained from the University of Munich Children's Hospital and ethical approval for the adult follow-up was granted by the Ethical Board of the University Hospital Bonn. Informed consent was provided by parents within 48 hours of their child's birth and participating adults gave fully informed written consent to the 26-year follow-up.

Participants

Of the 682 VP/VLBW individuals assessed in the larger study, 411 VP/VLBW were eligible for inclusion at the 26-year follow-up, and 260 participated (see Figure 4.1). Of these, 218 had sufficient peer relationships data (i.e., complete data on at least three of the four peer assessment timepoints at 6, 8, 13, and 26 years of age) and were thus included in the current study. Of the eligible healthy term-born children, 350 were randomly selected within two stratification variables (child sex and family SES) to be comparable to the VP/VLBW individuals, and 308 were eligible for inclusion at the 26-year follow-up. Of these, 229 participated in the adult follow up, and 220 with sufficient peer data were included in this study.

Measures

Predictors

Biological, medical, and socio-demographic variables at birth. Gestational age in weeks, birth weight and child sex were obtained from obstetric records. Infant neonatal medical risk was measured with a comprehensive index score comprised of 21 items representing medical complications (e.g. ventilation or intubation, severe anemia, cerebral hemorrhage; Schmid, Schreier, Meyer, & Wolke, 2010) with higher scores indicating more problematic neonatal course. Further details of this score are provided in Table A-11 in the Appendix.

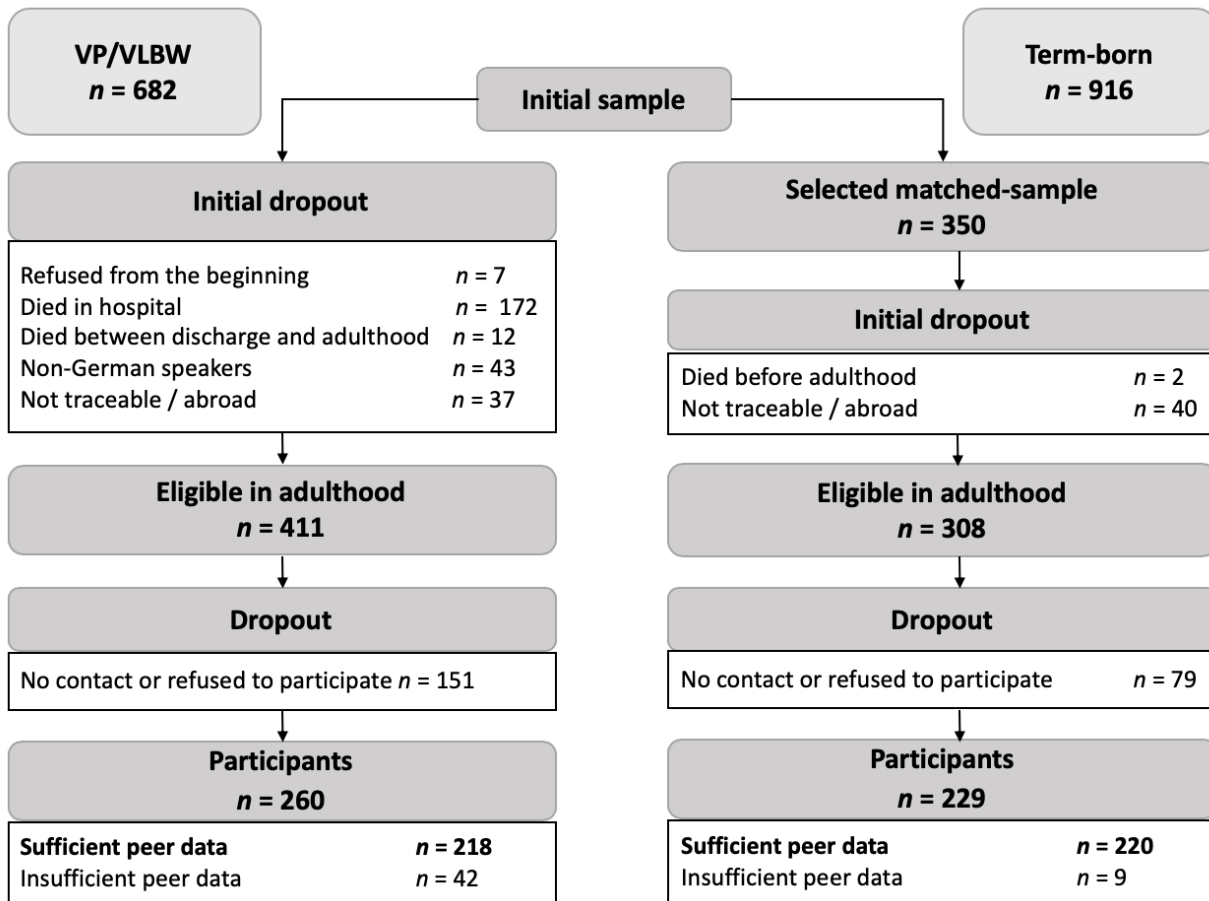


Figure 4.1: Flowchart of participants throughout the study.

Note. Participants were considered to have ‘sufficient peer data’ if they had complete data on any of the peer relationship domains for at least three of the four assessment timepoints.

Family socioeconomic status (SES) at birth was based on maternal and paternal highest education and occupational status and coded from 1 (lowest) to 6 (highest social class).

Parent-infant relationship. The Parent-Infant Relationship Index (PIRI) was used to assess attachment-related parental concerns, feelings, and behaviors from birth to five months (Breeman, Jaekel, Baumann, Bartmann, & Wolke, 2017). The instrument consists of eight ‘yes’ or ‘no’ items obtained by trained nurses’ observations and a standardized interview with the children’s parents. The following are examples of items included: *mother shows little pleasure when interacting with the child* (nurse’s observation, neonatal), *father visits infant one time per week or less on the neonatal ward* (father or mother interview, neonatal), and *mother has difficulties in establishing a relationship to the infant* (mother interview, at 5 months of age). The sum of responses was recoded into a binary variable (0 = some concern, i.e., poor parent-infant relationship; 1 = no concern, i.e., good parent-infant relationship). Details of this assessment are described Table A-12 in the Appendix (see also Breeman et al., 2017).

Inhibitory control at 20 months. Children’s inhibitory control abilities were measured with a standardized behavioral observation task adapted from the snack delay task (Jaekel, Eryigit-Madzwamuse, & Wolke, 2016; Kochanska, Murray, & Harlan, 2000) when the children were 20 months of age (corrected for prematurity). Children were presented with a raisin that was placed under an opaque plastic cup within reach. Three training runs were conducted on which children were allowed to eat the raisin after short but increasing time intervals (instant eating, then 5 and 10 seconds waiting time). At the end of each interval, the experimenter blew a whistle to indicate that the child was allowed to eat the raisin. When all three training runs had been completed, the actual test run was performed. The time that children waited before touching the raisin was measured with a stopwatch from 0 to 60 seconds. Since scores of reaction times

were not normally distributed, they were recoded into a binary score: 0 = did not wait or waited up to 10 seconds, i.e., poor inhibitory control (62%), and 1 = waited for ≥ 11 seconds, i.e., good inhibitory control (38%). The cut-off was based on normative reaction times at 20 months of age indicating meaningful differentiation of inhibitory control abilities (i.e., waiting for 0 to 10 seconds was classified as not waiting).

Cognitive abilities at 20 months. Early cognitive abilities were assessed with the Griffiths Mental Development Scale (GMDS; Brandt, 1983; Griffiths, 1970), a standardized developmental test administered by trained research pediatricians when the children were 20 months of age (corrected for prematurity). The GMDS assesses five dimensions of mental development: locomotor, personal-social development, hearing and speech, hand and eye coordination, and performance. A total developmental quotient across the 5 domains was computed according to German norms (Brandt, 1983). The GMDS has shown satisfactory reliability and good construct validity across different studies and cultures (Luiz, Foxcroft, & Stewart, 2001).

Peer Relationship Indicators

Peer acceptance. At age 6 and 8 years, children completed an adapted German version of the Pictorial Scale of Perceived Competence and Social Acceptance for Young Children (Asendorpf & Van Aken, 1993; Harter & Pike, 1984), subscale Peer Acceptance. The scale contains six items (described in the Appendix) that are presented via two pictures displaying a gender-matched child. Children pick the child to whom they are most similar and responses are coded on a four-point scale with greater values indicating higher acceptance. The six items are averaged into a *Peer Acceptance* index score (Heuser et al., 2018). Internal consistency was acceptable ($\alpha = .70$). Parents then answered a parallel version of the described items,

reformulated into questions. Internal consistency was good ($\alpha = .80$). To obtain a comprehensive score that included both parent and children's perspectives of the child's peer acceptance, child and parent index scores were each z-standardized and averaged into a joint Peer Acceptance z-score at 6 and 8 years.

At 13 years of age, participants completed a measure adapted from Nicholls' (Nicholls, 1978) work on self-concept of attainment. Adolescents were presented with a sheet of paper with 25 vertically aligned schematic faces, with polarizing statements at the top and bottom of the faces. They were then asked to select the face best representing how closely they identified with the top versus the bottom statement. The face closest to the top statement had a score of 25, and the face closest to the bottom had a score of 1, with the middle face having a score of 13. The following were the statements with scores of 25 in the peer subscale of the questionnaire: (1) *I make friends very easily*, (2) *I have many friends*, (3) *I am very popular with other children*, (4) *Other children like me very much*. On the opposite end were statements with a score of 1: (1) *I find it hard to make friends*, (2) *I have few friends*, (3) *I am not popular with other children*, (4) *Other children do not like me*. Items had acceptable internal consistency ($\alpha = .74$) and were z-standardized and averaged to create a Peer Acceptance z-score at 13 years.

At 26 years of age, participants rated themselves on two items parallel to and coded in the same way as those from the 13-year assessment: (1) *I make friends easily*, and (2) *I am very popular with others*. Items were z-standardized and averaged to create a Peer Acceptance z-score at 26 years.

Friendships. At 6 and 8 years, the semi-structured Friendship and Family Interview (Heuser et al., 2018) was used to assess the nature of children's friendships. Children were asked to name up to ten playmates or friends (siblings not included). These listed friends were summed

into a *Number of friends* index score. The children were also asked to name their best friends. Whether the child had at least one best friend was coded as a binary variable (0 = no, 1 = yes). To assess parents' perceptions of their children's friendships at 6 and 8 years of age, the structured *Mannheimer Parent Interview* (Esser, Blanz, Geisel, & Laucht, 1989), subsection *Contact with peers*, was administered. Parents were instructed to list up to eight friends. Parents were also asked whether the child had a best friend. Interviewers were trained over two months. All interviews were videotaped and double-rated by two psychologists. Interrater reliability was excellent with a Cohen kappa of > 0.95 . The child and parent's report of the number of friends were each z-standardized and then averaged into a *Number of friends z-score*. The child and parent's report of whether there was a best friend were recoded, z-standardized, and averaged into a *Best friend z-score*. The *Number of friends z-score* and the *Best friend z-score* were then averaged to create a Friendships z-score at each age (6 and 8 years).

At 13 years, adolescents and their parents were separately asked to indicate whether the child had at least one good friend, with the possible responses: 0 = certainly true, 1 = somewhat true, 2 = not true. Answers for both parents and adolescents' reports were recoded, z-standardized, and averaged into a *Good friend z-score*. Because individuals were not directly asked to list their friends in adolescence, as they had been at previous timepoints, their self-rating from 1 (*I don't have many friends*) to 25 (*I have many friends*) was z-standardized and used as a proxy for *Number of friends score*. This score was then averaged with the *Good friend z-score* to create a Friendships z-score at 13 years.

At 26 years, during a structured interview, participants were asked about their number of friends and whether they had at least one good friend. Responses on each of these two items were z-standardized and then averaged into a Friendships z-score at 26 years.

Peer problems. During the 6- and 8-year assessments, parents completed the widely-used Child Behavior Checklist (CBCL; Achenbach & Edelbrock, 1983; Döpfner, Schmeck, Berner, Lehmkuhl, & Poustka, 1994). The social problems subscale of the CBCL contained six items (e.g., *gets teased a lot*, *does not get along with other children*) with the following possible responses: 0 = not true, 1 = somewhat or sometimes true, 2 = very or often true. Responses were averaged and z-standardized to construct a Peer Problems z-score at both ages (6 and 8 years).

During the 13-year assessment, peer problems were assessed with parent and adolescent versions of the Strengths and Difficulties Questionnaire (SDQ; Goodman, 2001; Klasen, Woerner, Rothenberger, & Goodman, 2003) on which responses have the following options: 0 = not true, 1 = somewhat true, 2 = certainly true. For each version, responses to the following three items were averaged and z-standardized: (1) *tends to be a loner*, (2) *is bullied by others*, and (3) *gets on better with adults than other children*. The z-scores from parent and child reports were then averaged into a Peer Problems z-score at 13 years.

At 26 years, individuals completed the social problems subscale of the Young Adult Self Report (YASR; Achenbach, 1997). Six items that paralleled those from the 6- and 8-year CBCL and were combined and z-standardized into a Peer Problems z-score at 26 years. A summary with further details for all of the peer relationship indicators (i.e., Peer problems, Peer acceptance, and Friendships) is provided in Table A-13 in the Appendix.

Statistical Analyses

Preliminary and descriptive analyses were conducted using SPSS v.24 (IBM; Chicago, IL). Independent samples t-tests were performed to assess differences in Friends, Peer Acceptance, and Peer Problems z-scores between the VP/VLBW and term-born individuals at each age of assessment. Subsequently, latent profile analyses were performed with Mplus,

Version 8 (Muthén & Muthén, 2011-2018). Latent profile analysis (LPA) is a variant of latent class analysis (i.e., based on observed continuous rather than categorical variables) and is used to identify homogeneous subgroups within a sample through maximum likelihood (ML) estimation (Lanza & Cooper, 2016). For Peer Acceptance and Peer Problems, z-scores at the four timepoints were used as indicators of latent profiles. Due to lack of variation in the Friendships variable at the last timepoint (26 years), only the three earlier timepoints could be used as indicators in the LPA for Friendships. Models with increasing numbers of subgroups or “classes” were estimated, and the Bayesian information criterion (BIC), Akaike’s information criterion (AIC), sample size adjusted BIC (ssBIC), and Consistent Akaike Information Criterion (CAIC) were used as goodness of fit and parsimony criteria, along with entropy values and interpretability, to select the best class solution (McLachlan & Peel, 2004). Lower BIC, AIC, ssBIC, and CAIC indicate a better model fit. Entropy values closer to 1 indicate clearer delineation of classes (Celeux & Soromenho, 1996). Cases were assigned to classes based on posterior probabilities. Finally, multinomial and binary logistic regressions were used to test potential predictors of class membership in two steps. In the first step, the effect of VP/VLBW status alone was tested. In the second step, the following predictors were included in addition to VP/VLBW status: child sex, family SES, neonatal medical risk, good parent-infant relationship at 5 months, good inhibitory control at 20 months, and cognitive abilities at 20 months.

Results

Descriptive characteristics for the final sample are presented in Table 4.1. As expected, individuals in the VP/VLBW group had lower gestational age, lower birthweight, and higher neonatal medical risk scores than the term-born group. Additionally, there were greater

Table 4.1: Descriptive Characteristics of the Sample by VP/VLBW Group Status (N= 438)

	VP/VLBW n= 218	Term-born n = 220	t / χ^2
Gestational age, weeks <i>M (SD)</i>	30.60 (2.24)	39.6 (1.11)	53.12***
Birth weight, grams <i>M (SD)</i>	1,342.39 (315.41)	3,358.68 (448.41)	54.47***
Sex, % male	53.7%	46.4%	2.34
Socioeconomic status <i>M (SD)</i>	3.49 (1.43)	3.18 (1.52)	-2.21*
Neonatal medical risk score <i>M (SD)</i>	-9.06 (2.70)	-0.39 (0.65)	45.99***
% with good early parent-infant relationship	54.8%	71.8%	14.36***
% with good inhibitory control at 20 months	18.3%	50.5%	49.97***
Cognitive abilities at 20 months <i>M (SD)</i>	96.21(16.30)	106.93(6.34)	8.87***

Note: * $p < .05$, ** $p < .01$, *** $p < .001$. Data are presented as *mean (standard deviation)* for continuous / interval scaled and *percentages* for categorical variables.

proportions of good parent-infant-relationships, good inhibitory control and higher cognitive abilities in the term-born group than the VP/VLBW group.

Results for independent samples t-tests assessing differences in friends, peer acceptance, and peer problems z-scores between the VP/VLBW and term-born groups at each assessment timepoint are presented in Table 4.2. At all timepoints, the VP/VLBW group had lower peer acceptance and friendships z-scores and higher peer problems z-scores than the term-born group.

Peer Acceptance

The LPA for peer acceptance (Figure 4.2a) supported a three-profile solution with lowest BIC (3824.06). Goodness of fit statistics for all of the latent profile models are shown in Table A-1 in the Appendix. The average posterior probabilities of the final latent profile assignment were good (.86).

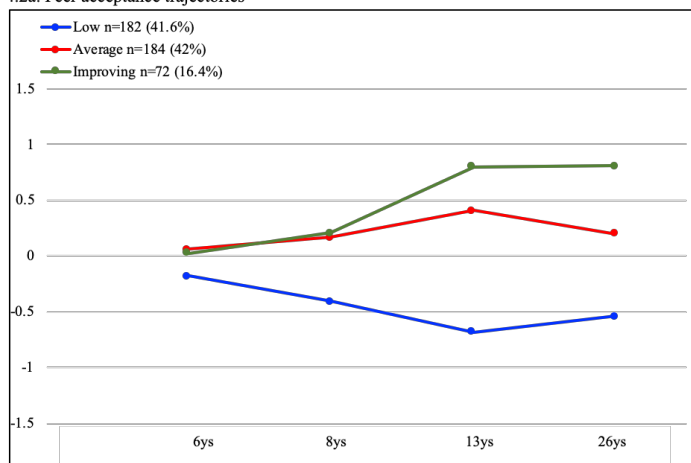
The three profiles show an “Average” peer acceptance trajectory (42% of the total sample), a “Low” peer acceptance trajectory (41.6% of the total sample) and an “Improving” peer acceptance trajectory (16.4% of the sample). The Average trajectory profile was comprised of individuals who had peer acceptance z-scores within half of a standard deviation from the mean across all timepoints. The Low trajectory profile was characterized by lower peer acceptance z-scores than the average group that also appeared to decrease over time, particularly in adolescence. The Improving trajectory group was the smallest and included individuals with scores similar to the Average trajectory group in childhood, but whose scores improved significantly in adolescence and adulthood.

Results of multinomial logistic regressions testing the effect of VP/VLBW status showed that being in the VP/VLBW group was associated with increased odds of being in the Low peer acceptance trajectory profile (OR: 1.52 [CI: 1.01 - 2.29]) compared to the Average peer

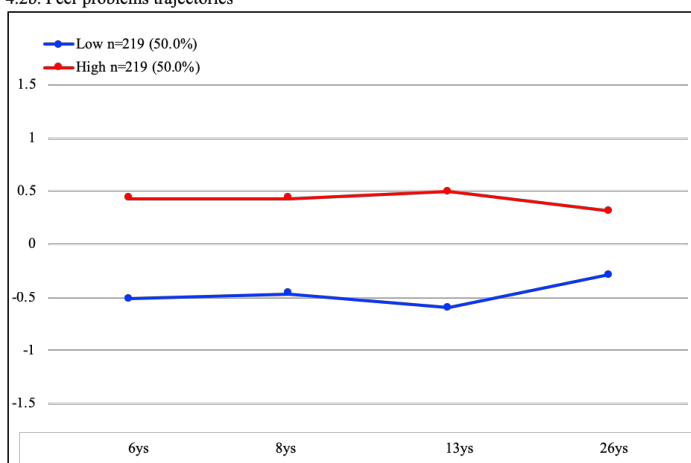
Table 4.2: Mean z-scores by VP/VLBW versus Term-born Controls in Peer Problems, Peer Acceptance, and Friends at each Timepoint

Measure	Age	VP/VLBW	Term-born	t	Mean difference
Peer Acceptance	6	-0.17 (0.85)	0.06 (0.76)	2.93**	0.24
	8	-0.17 (0.79)	0.04 (0.75)	2.90**	0.22
	13	-0.10 (0.85)	0.12 (0.67)	2.89**	0.22
	26	-0.15 (1.03)	0.12 (0.75)	3.12**	0.27
Peer Problems	6	0.22 (1.08)	-0.28 (0.76)	-5.52***	-0.50
	8	0.16 (1.08)	-0.20 (0.82)	-3.90***	-0.36
	13	0.13 (0.97)	-0.22 (0.72)	-4.17***	-0.35
	26	0.13 (1.11)	-0.12 (0.83)	-2.60*	-0.25
Friendships	6	-0.05 (0.55)	0.10 (0.47)	2.94**	0.15
	8	-0.10 (0.64)	0.17 (0.54)	4.75***	0.27
	13	-0.12 (0.93)	0.15 (0.52)	3.61***	0.27
	26	-0.05 (0.86)	0.12 (0.57)	2.36*	0.17

4.2a. Peer acceptance trajectories



4.2b. Peer problems trajectories



4.2c. Friendships trajectories

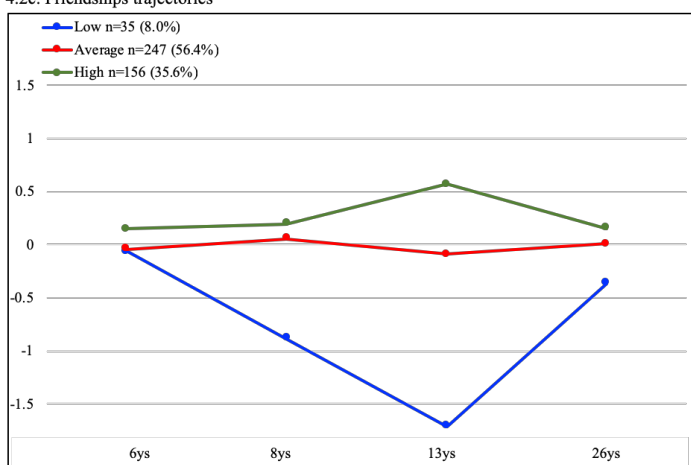


Figure 4.2: Mean z-scores for trajectories in the full sample (N = 438)

acceptance trajectory profile. However, when predictors (i.e., sex, SES, neonatal medical risk, good parent-infant relationship, good inhibitory control, and cognitive abilities) were included in the model (Table A-2 in the Appendix), only cognitive abilities were significantly associated with class membership. Specifically, higher cognitive abilities were associated with lower odds of being in the Low peer acceptance trajectory compared to the Average trajectory (OR: .97 [.95 - .99]).

Peer Problems

The LPA for peer problems (Figure 4.2b) supported a two-profile solution with lowest BIC (4090.98) and highest entropy (.75). The average posterior probabilities of the final latent profile assignment were excellent (.93). The profiles depict a “High” peer problems trajectory (50% of the total sample) with z-scores above the mean across all timepoints, and a “Low” peer problems trajectory (50% of the total sample), with z-scores below the mean across all timepoints. Binary logistic regressions showed that being in the VP/VLBW group was associated with decreased odds of being in the Low peer problems trajectory (OR: .44 [.30 - .65]). However, when all predictors were included in the model (Table A-3 in the Appendix), VP/VLBW status was no longer significant. Instead, higher cognitive abilities were associated with increased odds of being in the Low peer problems trajectory (OR: 1.06 [1.04 - 1.09]). Additionally, good parent-infant relationship at 5 months was also associated with increased odds of being in the Low peer problems trajectory (OR: 1.61 [1.03 - 2.50]).

Friendships

The LPA for friendships (Figure 4.2c) supported a three-profile solution (BIC: 1944.47, entropy = .77). The average posterior probabilities of the final latent profile assignment were good (.90). The three friendships profiles show an “Average” trajectory (56.4% of the total

sample), a “Low” trajectory (8% of the total sample) and a “High” trajectory (35.6% of the sample). The Average friendships trajectory profile was comprised of individuals who had friendships z-scores close to the mean across all timepoints. The Low friendships trajectory profile was the smallest and was characterized by friendships z-scores that were similar to the average group at 6 years but decreased significantly at 8 years and even more in adolescence, then rose closer to (but still lower than) the average group in adulthood. The High trajectory group included individuals with scores that were slightly higher than the Average trajectory group at all timepoints.

Results of multinomial logistic regression showed that being in the VP/VLBW group was associated with increased odds of being in the Low friendships trajectory profile (OR: 2.36 [1.09 - 5.13]) compared to the Average friendships trajectory profile. However, when all predictors were included in the model (Table A-4 in the Appendix), only cognitive abilities were significantly associated with class membership. Specifically, higher cognitive abilities were associated with increased odds of being in the High friendships trajectory compared to the Average trajectory (OR: 1.03 [1.00 - 1.05]).

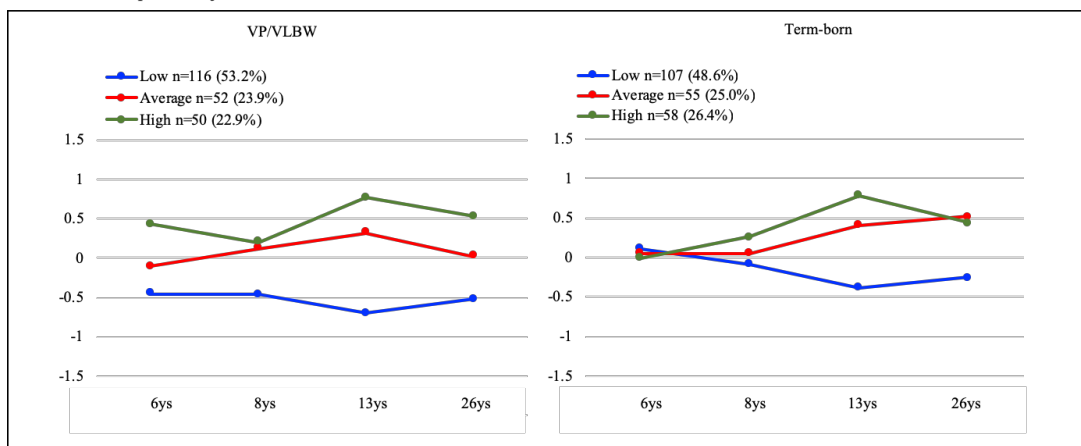
Subgroup analyses

Peer acceptance. When the LPA was performed separately for the index versus control subgroups, a three-profile solution continued to have the best fit for peer acceptance trajectories in the VP/VLBW group (AIC: 1882.77, ssBIC: 1892.25) and the term-born group (AIC: 1748.43, ssBIC: 1758.32). Consistent with the LPA for the full sample, profiles included Low, Average, and High peer acceptance trajectories that contained similar proportions of cases across subgroups (VP/VLBW: low = 53.2%, average = 23.9%, high = 22.9%; term-born: low = 48.6%, average = 25%, high = 26.4%). However, for the VP/VLBW subgroup, mean scores for

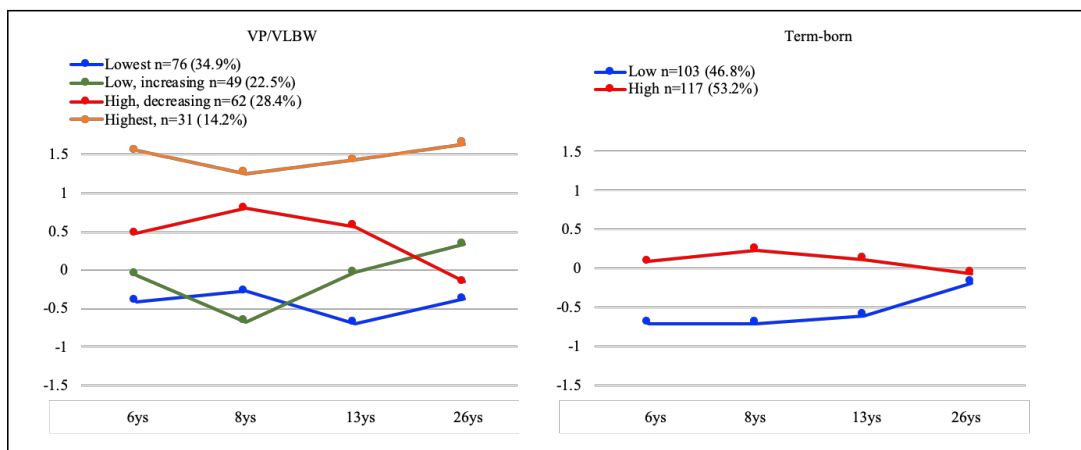
trajectories were differentiated early on (i.e., at 6 years), whereas for the term-born group, mean scores overlapped at 6 years, but began differentiating at 8 years, with differences becoming most apparent in adolescence (Figure 4.3a). Moreover, multinomial logistic regressions showed that significant predictors varied across subgroups. In the VP/VLBW group, higher cognitive abilities predicted increased odds (OR: 1.08 [1.03 - 1.13]) of being in the High peer acceptance trajectory compared to the Average trajectory (Table A- 5 in the Appendix). In contrast, in the term-born subgroup, only male sex predicted decreased odds (OR: 0.43 [0.20 – 0.96]) of being in the High peer acceptance trajectory compared to the Average trajectory (Table A-6 in the Appendix).

Peer Problems. The LPA for peer problems in the separate subgroups indicated that the optimal number of profiles differed in the solution for the VP/VLBW versus the term-born group (Figure 4.3b). In contrast to the analysis in the full sample and term-born subgroup, in which a two-profile solution had the best fit, a four-profile solution had superior fit in the VP/VLBW group (AIC: 2056.27, ssBIC: 2068.99, entropy = .82). These four profiles depicted trajectories that varied in levels of peer problems, from lowest to highest (Lowest = 34.9%, Low, increasing = 22.5%, High, decreasing = 28.4%, Highest = 14.2%). Multinomial logistic regressions showed that significant predictors also varied across subgroups. In the VP/VLBW subgroup (Table A-7 in the Appendix), when compared to the Lowest peer problems trajectory, higher cognitive abilities were associated with decreased odds of being in the Low, increasing trajectory (OR: .90 [.86 - .94]), High, decreasing trajectory (OR: .94 [.90 - .99]), and Highest peer problems trajectory (OR: .89 [.85 - .94]). Additionally, good parent-infant relationship quality at 5 months predicted decreased odds (OR: .13 [.04 - .40]) of being in the Highest peer problems trajectory

4.3a. Peer acceptance trajectories



4.3b. Peer problems trajectories



4.3c. Friendships trajectories

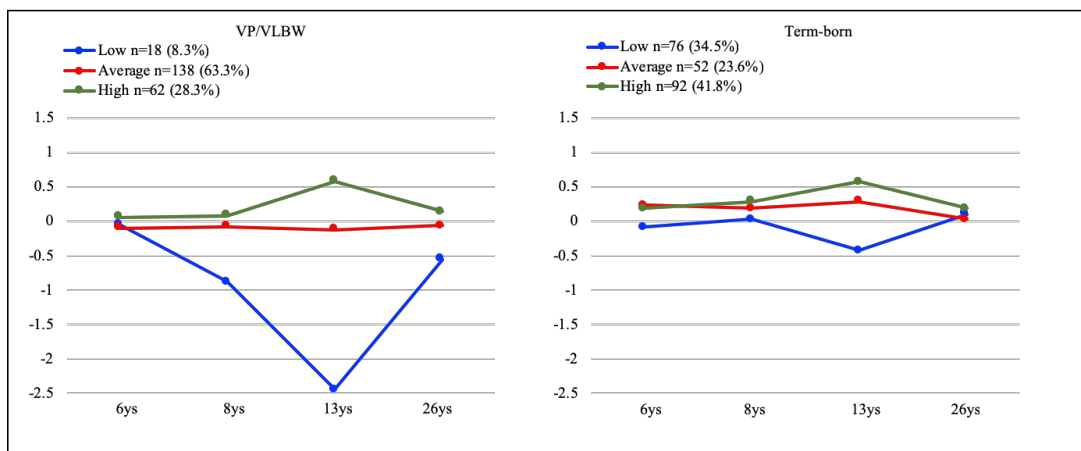


Figure 4.3: Mean z-scores for trajectories in the VP/VLBW (n = 218) versus term-born (n = 220) groups

compared to the Lowest peer problems trajectory. Male sex also predicted increased odds of being in the Highest peer problems trajectory (OR: 2.99 [1.05 - 8.52]). In the term-born subgroup, only lower SES predicted decreased odds (OR: .77 [.64 - .93]) of being in Low peer problems trajectory compared to the High peer problems trajectory (Table A-8 in the Appendix).

Friendships. Consistent with analyses in the full sample, the LPA for friendships (Figure 4.3c) also supported a three-class solution for the VP/VLBW (AIC: 1044.95, BIC: 1143.10, ssBIC: 1051.21) and term-born (BIC: 830.77) subgroups. However, multinomial logistic regressions showed there were no significant predictors of class membership in either subgroup. In the VP/VLBW group, cognitive abilities and sex approached but did not reach significance ($p = .053$ for both). In the term-born group, SES approached but did not reach significance ($p = .055$). Results of multinomial logistic regressions are shown in Tables A-9 and A-10 in the Appendix.

Discussion

The current study explored trajectories across three domains of peer relationships from childhood to early adulthood in VP/VLBW and term-born individuals. As hypothesized, better early cognitive abilities were associated with more optimal trajectories in peer acceptance, peer problems, and friendships. Additionally, good early parent-infant relationships were associated with reduced peer problems trajectories. Generally, trajectories showed more differentiation in the VP/VLBW group than the term-born group, and the effect of predictors became stronger when analyzing the VP/VLBW subgroup separately but disappeared in the term-born group. Instead, demographic variables including child sex and family SES were the only significant

predictors in the term-born subgroup analyses. In contrast to our hypothesis, early inhibitory control was not associated with trajectories in either subgroup, nor in the entire sample.

Consistent with models of preterm individuals' socioemotional development that highlight the role of biological vulnerability (Montagna & Nosarti, 2016), our findings support the hypothesis that general cognitive problems may underlie social difficulties across multiple domains, including peer acceptance, peer problems and friendships. Various studies suggest that poor cognitive abilities may contribute to negative social interactions (Clark, Prior, & Kinsella, 2002; Hughes et al., 2000). Moreover, a study of 6-12 year-old VP and term-born children found that child IQ mediated the association between VP birth and socioemotional problems (Bayless, Pit-ten Cate, & Stevenson, 2008). In the same study, the association between low IQ and socioemotional problems was more pronounced in the VP than the term-born group. Consistent with this literature, our study showed that general cognitive abilities as early as 20 months age predict peer relationships trajectories into early adulthood, especially for VP/VLBW individuals. The effect of VP/VLBW disappeared once cognitive ability was entered in logistic regression. This suggests that the effects of VP/VLBW on social trajectories may be mediated by low early cognitive ability. This is likely, considering that low cognitive abilities detected in toddlerhood are highly stable in VP/VLBW children into adulthood but less so in term-born children (Breeman, Jaekel, Baumann, Bartmann, & Wolke, 2015; Linsell, Johnson, Wolke, O'Reilly, et al., 2018).

Moreover, these findings provide evidence that modifiable factors, such as the early social environment, may also have an important role in shaping trajectories, specifically in the peer problems domain. Consistent with studies reporting that more adaptive parenting is associated with preterm children's higher social skills and socio-emotional regulation (Jones et

al., 2013; Treyvaud et al., 2009), our study found that as early as 5 months of age, good parent-infant relationships predicted lower peer problems trajectories. Nonetheless, given that parenting strategies are actively influenced by children's unique characteristics (Belsky, 1984; Neece, Green, & Baker, 2012), their transactional influence on parents' behaviors should be acknowledged (Treyvaud, 2014). For instance, mothers of preterm children have been shown, on average, not to be less sensitive than mothers of full-term children (Bilgin & Wolke, 2015), but instead, appear to adapt their parenting strategies to their child's cognitive status (Jaekel et al., 2012). Notably, our study found a significant effect of parent-infant relationships even while including child cognitive abilities in the model. Previous research has shown that better parenting itself is related to higher cognitive scores in adults' born preterm (Breeman et al., 2017). Thus, future studies that consider transactional associations between child characteristics, such as cognitive abilities, and parenting behaviors that influence the parent-infant relationship are needed to help disentangle the complex mechanisms involving children's inputs into their own social environments.

In contrast to our hypothesis, inhibitory control was not associated with any of the outcomes tested. This was surprising, given that in a recent study, early inhibitory control partially mediated the relationship between gestational age and friendships at 8 years of age (Reyes et al., 2019). Inhibitory control is a modifiable factor that may improve throughout childhood, and even small increases in childhood self-control may confer long-term benefits (Moffitt et al., 2011). Thus, individual differences at later ages could be more closely related to long-term peer relationship trajectories than inhibitory control in toddlerhood.

This study has many strengths. This is the first study to explore preterm children's peer relationship trajectories across multiple domains from childhood to early adulthood. Data was

collected from a large, prospective, whole-population sample, followed longitudinally from birth to 26 years of age. Outcome measures of peer acceptance, peer problems, and friendships consisted of standardized instruments and in-depth interviews that included both individuals' self-perceptions and parents' reports. Predictors were also measured with previously validated standardized behavioral observations (e.g., inhibitory control; Kochanska et al., 2000), multiple informants (e.g., nurses' observations and parent interviews about parent-infant relationship) and standardized, pediatrician-administered developmental assessments (e.g., cognitive abilities; Griffiths, 1970). Analyses included background predictors such as child sex, neonatal medical risk, and family SES.

This study also has limitations. Improved neonatal care has substantially increased survival of preterm infants over the past decades, warranting replications with more recent cohorts. Nevertheless, in general, the long-term neurodevelopmental outcomes after preterm birth appear to be comparable, even in more recent samples (Cheong et al., 2017; Pierrat et al., 2017; Wolke et al., 2019). Additionally, although our findings established early predictors of peer relationship trajectories into early adulthood, we did not test more complex associations such as mediation and moderation. Thus, future studies may consider testing whether early cognitive abilities mediate the relationships between VP/VLBW and peer trajectories, as well as whether VP/VLBW status and good parenting moderate these associations. Further, future studies could include perceptions of teachers and other peers to measure peer relationship constructs and have more precise measures in young adulthood, particularly for friendships.

In conclusion, the current study found evidence of early life predictors of peer relationship trajectories from childhood into early adulthood, thus providing new insights into the potential mechanisms of long-term social difficulties in preterm samples. Moreover, findings

of this study highlight the importance of early biological vulnerabilities and environmental factors for peer relationships from childhood to adulthood, indicating that both early parent-child relationships and toddlers' cognitive abilities predict more adaptive peer relationships for VP/VLBW individuals. Future research should continue to explore the impact of preterm birth on social relationships, and the mechanisms through which early factors contribute to long-term social, emotional, and occupational functioning, with the aim of identifying appropriate early interventions.

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Chapter 5:**Conclusion**

The development of peer relationships in childhood is foundational for socialization throughout the lifespan (Hartup & Stevens, 1997). Understanding how preterm birth confers vulnerability for various aspects of peer relationships can elucidate early intervention targets that may promote healthy life-long development. Therefore, the current dissertation explored potential mechanisms underlying the impact of preterm birth on peer relationships. Using data from the Bavarian Longitudinal Study, this collection of studies examined the role of internal and external factors, ranging from biological to environmental risk (Beauchamp & Anderson, 2010; Montagna & Nosarti, 2016), on social development. Specifically, preterm birth, neonatal medical risk, cognitive abilities, temperamental characteristics, and parent-infant relationship quality were explored as predictors of peer relationship outcomes in preterm and term-born individuals from 6 to 26 years of age. In general, it was found that preterm birth is associated with suboptimal peer relationships, which can be predicted by early life factors, including toddler's poor inhibitory control and general cognitive abilities, and social inhibition at 6 years of age. Moreover, good parent-infant relationships appear to protect preterm individuals from social problems across time.

To explore potential pathways from preterm birth to social development, this dissertation first focused on temperament, as previous literature has shown that there are differences in temperamental characteristics between preterm and term-born children (Cosentino-Rocha Klein, & Linhares, 2014; Jaekel, Eryigit-Madzwamuse, & Wolke, 2016; Reyes, Jaekel, & Wolke, 2019), and that temperamental differences account for some of the variation in social outcomes in the general population (Bohlin, Hagekull, & Andersson, 2005; Gal-Szabo, Spinrad, Eisenberg, & Sulik, 2019). Moreover, in this study we compared temperamental profiles of preterm children to those of post-institutionalized children, in order to explore potentially shared underlying

mechanisms. Results showed that preterm birth and early institutionalization were similarly associated with lower effortful control. These findings suggest that lower effortful control may underlie similarities in behavioral problems of both preterm and post-institutionalized children. Future studies should explore whether lower effortful control in early childhood mediates long-term social problems following early adversity.

Furthermore, results indicated that preterm birth was associated with lower shyness and no differences in sociability compared to full-term controls at six years of age. This was a surprising finding given that, in previous literature, adults born with extremely low birth weight report higher shyness and lower sociability than normal birth weight controls in their early and mid 20s (Eryigit-Madzwamuse, Strauss, Baumann, Bartmann, & Wolke, 2015; Schmidt et al., 2008). These results may suggest that there are additional socialization challenges beyond early childhood that may contribute to the withdrawn personality factor seen in adults born VP/VLBW (Eryigit-Madzwamuse et al., 2015). Such challenges may include increased bullying (Wolke et al., 2015) or difficulties making friends (Heuser, Jaekel, & Wolke, 2018) and may be particularly influential given that VP/VLBW have been shown to be more vulnerable to adverse social stimulation (Jaekel, Pluess, Belsky, & Wolke, 2015; Wolke, Jaekel, Hall, & Baumann, 2013). Thus, these findings highlight the need for studies that explore multiple cumulative factors, such as in developmental cascade models (Masten & Cicchetti, 2010), that contribute to trajectories of preterm children's social functioning, in order to better understand problematic outcomes in adulthood.

Having identified temperamental differences in the previous study as a potential mechanism for preterm children's social problems, in the second study, we explored whether temperamental characteristics affected by preterm birth mediated a developmental cascade from

preterm birth to social relationships at 8 years of eight years of age. Specifically, we explored the role of inhibitory control at 20 months and social inhibition at 6 years of age. In this study, we characterized friendships with an index score that contained both parents' and children's reports of the child's number of friends, frequency of contact with these friends, and peer acceptance. We bolstered our methodology by including standardized observations of specific traits (i.e., inhibitory control and social inhibition), as opposed to only parent reports of broader temperamental characteristics (i.e., effortful control and shyness). Whereas in the first study we explored temperament as a continuum and not necessarily related to behavioral problems, in this study, we employed dichotomous categories reflecting significant deviation from norms to characterize high social inhibition. Moreover, we included an index of parent-infant relationships at 5 months to assess a potential external influence that may also contribute to differences in peer relationships. Results showed evidence of a developmental cascade from gestational age to parent-infant relationships, to inhibitory control, and to social inhibition that partially explained differences in friendships at 8 years of age. Nonetheless, this model only explained a small amount of variance in friendships, with gestational age having the largest effect size. These findings suggest that, although good early parent-infant relationships, good early inhibitory control, and lower social inhibition at 6 years of age contribute to better friendship scores at 8 years, other mechanisms not tested in this model may account for the remaining variance in peer relationship outcomes.

Therefore, in the third study of this dissertation, we tested early cognitive abilities as an additional potential predictor of peer relationships, while including previous predictors (i.e., VP/VLBW status, neonatal medical risk, inhibitory control, and parent-infant relationship). We extended the analyses to outcomes from 6 to 26 years of age and tested patterns in the full

sample as well as separately for the preterm and term-born samples, in order to explore heterogeneity within subgroups. Moreover, we employed more precise characterizations of social relationships (e.g., Narr et al., 2019) by exploring trajectories across three different domains: peer acceptance, friendships, and peer problems. Results showed that higher cognitive abilities at 20 months of age were associated with optimal trajectories in all peer relationship domains. For peer acceptance and friendships, a trajectory was considered optimal or suboptimal in relation to the “average” trajectory (i.e., the trajectory with means closest to zero). Thus, the highest trajectory was optimal, whereas the lowest trajectory was suboptimal. For peer problems, the lowest trajectory was the reference, thus anything higher was considered suboptimal.

In addition, good early parent-infant relationships at 5 months of age were associated with lower peer problems trajectories. Subgroup analyses showed that significant predictors differed for the VP/VLBW and term-born samples. Specifically, cognitive abilities appeared to matter more for the VP/VLBW group than the term-born group, whereas demographic variables (such as SES and sex) were more influential in the term-born group.

Thus, collectively, these studies provide support for three potential mechanisms described below that contribute to VP/VLBW individuals’ social problems. First, preterm birth appears to increase the risk for regulatory problems (low inhibitory control and high social inhibition) that lead to poorer peer acceptance and fewer friendships. Second, toddlers’ cognitive deficits may partially account for the effect of VP/VLBW birth on trajectories of friendships, peer acceptance and social problems from childhood to early adulthood. Third, good parent-infant relationships may protect preterm children from peer problems, even when other risks (i.e., early temperamental characteristics, early cognitive deficits) are taken into account.

Temperament and Early Regulation

In the first two studies, we found evidence that VP/VLBW predicted temperamental characteristics, particularly those related to regulatory abilities. Specifically, we showed that (1) VP/VLBW children have lower levels of effortful control at 6 years than full-term children, (2) lower gestational age predicts lower inhibitory control at 20 months, which in turn, predicts high social inhibition at 6 years, and (3) lower gestational age is associated with poor parent-infant relationships, which in turn, predict poor inhibitory control at 20 months. Toddlers' inhibitory control had both direct and indirect (via social inhibition) effects on a composite score that represented the quality and quantity of children's friendships and peer acceptance at 8 years of age.

In contrast, in the third study, toddlers' inhibitory control did not have a significant effect on friendship trajectories from childhood to adulthood when other relevant predictors were included. This discrepancy could be due to changes in inhibitory control abilities throughout childhood and adolescence. Although childhood self-control predicts various social outcomes in adulthood with strong effect sizes (Caspi et al., 2016), it has also been shown to be malleable in childhood and adolescence (Diamond & Lee, 2011; Moffitt et al., 2011; Piquero, Jennings & Farrington, 2010). Thus, it is possible that gains in various forms of self-control could have attenuated the relationship between inhibitory control at 20 months and trajectories of peer relationships into adulthood. Nonetheless, these findings suggest that early temperamental and regulatory mechanisms may contribute to the development of children's peer relationships, especially early in life.

Early Cognitive Abilities

In the third study, we also found evidence for cognitive abilities as a mechanism linking preterm birth with peer relationships outcomes. Specifically, cognitive abilities at 20 months of age predicted trajectories in three specific domains of peer relationships (i.e., friendships, peer acceptance, and peer problems) from childhood to early adulthood, controlling for other relevant variables. Moreover, cognitive abilities accounted for the effect of VP/VLBW on peer relationship outcomes, as this significant effect disappeared when cognitive abilities were introduced in the model. Interestingly, this pattern was present for the full sample and VP/VLBW subgroup, but not for the term-born group. Given that cognitive difficulties are more stable in VP/VLBW individuals than term-born comparisons (Breeman, Jaekel, Baumann, Bartmann, & Wolke, 2015; Linsell, Johnson, Wolke, O'Reilly, et al., 2018), the effect of these difficulties in VP/VLBW individuals' peer relationships is likely to be more persistent. Accordingly, peer relationship trajectories were more differentiated early on (at 6 and 8 years of age) for the VP/VLBW group, whereas the term-born group showed greater differentiation in trajectories in adolescence.

Parent-Infant Relationship

The most complex mechanism for which we found evidence was related to early parent-child relationships. In both the second and third studies, parent-infant relationships at 5 months contributed to social outcomes, but there were important considerations to note. Specifically, parent-infant relationships at 5 months predicted trajectories of peer problems in the third study. However, there was not a direct effect of parent-infant relationships at 5 months on the friendships composite score at 8 years in the second study, nor on trajectories of friendships and peer acceptance from 6 to 26 years of age in the third study. Importantly, in the second study,

good parent-infant relationships predicted good inhibitory control at 20 months, which in turn, predicted higher friendships scores. Taken together, these findings may indicate that the effect of early parent-infant relationships on later peer relationships is primarily mediated through self-regulatory abilities that lead to appropriate social behaviors (e.g., Contreras, Kerns, Weimer, Gentzler, & Tomich, 2000). However, there are additional possible transactional relations to be taken into account.

First, VP/VLBW infants' medical problems and the stressful conditions related to NICU hospitalizations contribute to parental stress and mental health problems (Bakewell-Sachs, & Gennaro, 2004; Shandor Miles, Holditch-Davis, Schwartz, & Scher, 2007), including concerns reflected in the parent-infant relationship at 5 months. Accordingly, parents of preterm infants had lower proportions of "good" parent-infant relationship index scores in our studies compared to parents of full-term controls. Nonetheless, there was variation in parent-infant relationship quality in every gestational age category, including the VP/VLBW group, in which about 50% had "good" versus "poor" parent-infant relationships (compared to 69% "good" in the full-term group, in our second study). Moreover, in both studies, the effect of parent-infant relationships was above and beyond the effect of VP/VLBW status and neonatal medical risk. Thus, it is likely that the parental feelings and behaviors that comprised our parent-infant relationship quality index (e.g., anxiety about taking care of the infant; showing pleasure during interaction with the infant) had unique contributions on children's later social problems. Indeed, the literature based on the general population has consistently shown similar effects of early parental feelings and behaviors on parent-child interactions, and in turn, on children's social outcomes (Isley, O'Neil, Clatfelter, & Parke, 1999; Petit & Harrist, 1993; Milgrom et al., 2004). Additionally, preterm children have been shown to be even more vulnerable to the effects of poor parenting than their

full-term counterparts (Jaekel, Pluess, Belsky, & Wolke, 2015), which could explain why there was not a significant effect of parent-infant relationships in outcomes for the term-born subgroup in our third study. Nonetheless, it is important to note that given our binary coding (due to skewed data distribution), we were unable to determine specifically which of the eight parental feelings, concerns, and/or behaviors in our parent-infant relationship measure constituted the “poor” parent-infant relationship quality category for each participant. Given that specific feelings, behaviors, and concerns may have different effects on parent-infant interactions, future research that more precisely examines how factors constituting the parent-infant relationship impact life-course peer relationship trajectories in preterm individuals may be useful in clarifying these associations.

Second, children’s characteristics also influence the parent-child relationship. Thus, it may be that the same child factors that contributed to more positive relationships with parents early on (e.g., less damage to neural structures involved in self-regulation) also contributed to better peer relationships as children grew older. For instance, studies have shown that VP/VLBW children’s mothers adjust their parenting strategies according to their children’s cognitive status, showing more positivity and less intrusiveness when children have higher cognitive abilities (Jaekel, Wolke, & Chernova, 2012). Therefore, although we tested the effect of earlier parent-infant relationship quality (at 5 months) on later child characteristics (at 20 months), it is likely that the preterm birth-related brain injuries and superimposed damage to structures involved in the development of inhibitory control and cognitive abilities (Volpe, 2009) would already have started influencing parent-child interactions at 5 months, even before these more discrete functional outcomes were solidified or assessed.

Third, parent-child relationships are only one of the multiple ways in which parents shape their children's social lives. Parents influence children's social relationships via various pathways, including parent-child interactions, direct instruction (such as advice giving), modeling behaviors, and the provision of opportunities for socialization (Parke, Burks, Carson, Neville, & Boyum, 1994). Whereas parent-infant interactions may serve as a way for children to learn appropriate social behaviors and working models of social relationships to use when interacting with peers (Contreras & Kerns, 2000; O'Neil & Parke, 2000), parental behaviors such as organizing playdates and extracurricular activities provide opportunities to make friends and form peer groups. It has been shown that all of these forms of parental influence predict children's social competence (i.e., the skills needed to form positive relationships) in middle childhood and in turn their peer acceptance one year later (McDowell & Parke, 2009). Given that the measure in our study only captured very early parent-infant interactions, future studies that more specifically assess parents' roles in their VP/VLBW children's socialization from the preschool years to adolescence are needed for a more comprehensive understanding of their social trajectories.

Finally, parental mental health may have a more direct link on children's social problems based on genetic risk for psychopathology. Many mental health disorders are known to have hereditary components and result in a phenotype marked by social problems such as those assessed in our study (e.g., being too dependent, not getting along with others). Thus, such shared genetic vulnerability between parents and children could manifest independently in both parental mental health problems (that contribute to poor parent-infant relationships) and children's peer problems. Moreover, early adverse experiences, such as preterm birth and

parental mental health problems during a sensitive period of development (i.e., infancy; Murray et al., 2003), could activate this vulnerability (Leve et al., 2010).

Strengths and Limitations

Strengths of this collection of studies include data from a large, prospective longitudinal study of preterm children and term-born comparisons from birth to 26 years of age. Moreover, data included multi-informant measures, including child, adolescent, and adult self-reports, parent reports, nurses' observations, and standardized assessments administered by trained pediatricians and psychologists. Additionally, we used novel methodological approaches, including data harmonization, path modeling, and latent profile analyses to test models that have not been previously tested longitudinally in preterm samples.

As described in all three studies, limitations of the current dissertation include the age of the sample, which was recruited in the 1980s. Since neonatal care has substantially improved over the past decades, replications with more recent cohorts are warranted. However, it is worth noting that the long-term neurodevelopmental outcomes after preterm birth appear to be generally comparable, even in more recent samples (Wolke et al., 2019). Moreover, as noted above, our measures had limitations. For instance, the binary coding of the parent-infant relationships index used in the second and third studies is limited, given that having a "poor" parent-infant relationship could represent a range of different concerns, some of which may relate directly to the child's preterm status. Nonetheless, this variable was predictive in analyses that controlled for gestational age and neonatal medical risk, thus suggesting a unique influence, beyond preterm birth-related risk or complications only. Future studies should include more precise measures of infant-parent relationships that can account for transactional effects. Moreover, ratings of friendships, peer acceptance, and social problems could be further

strengthened by including the perceptions of teachers and other peers in addition to parent and self reports, and by having more developmentally appropriate measures in young adulthood.

Future Directions

In summary, this collection of studies contributes to the field with new knowledge and in various methodological ways. First, we showed that cross-validating data from multiple cohorts can provide a useful avenue to explore shared mechanisms after early adversity, and for the first time, that preterm birth and institutional deprivation appear to ipredict effortful control to similar extents at 6 years of age. Future research can build on these efforts by using similar data-harmonization strategies and comparing long-term outcomes after different adversities. Moreover, effortful control can be explored as a shared underlying mechanism mediating effects of early adversity and long-term social problems. Secondly, we showed a cascade of vulnerability from lower gestational age to friendships at 8 years of age. Future studies can expand this model to include other potential mechanisms, such as cognitive abilities that may account for additional variance in friendships. Third, we conducted the first study of preterm children's peer relationship trajectories across multiple domains from childhood to early adulthood and showed that early life factors can predict these trajectories. Moreover, we showed that early predictors of long-term social outcomes vary in VP/VLBW versus term-born controls. This suggests that future studies should consider unique models of preterm children's social development (e.g., Montagna & Nosarti, 2016) and employ subgroup analyses to test these in comparison to healthy full-term samples (e.g., Lean et al., 2019).

In conclusion, preterm birth is associated with suboptimal peer relationships, which can be predicted by early life individual and environmental factors. Individual factors – specifically, early low cognitive abilities – appear to be the strongest predictors of VP/VLBW individuals'

social difficulties in peer acceptance, friendships, and peer problems from childhood to adulthood. Good regulatory abilities in toddlerhood promote higher peer acceptance and friendships during school age. Good parent-infant relationships appear to reduce preterm children's risk for long-term peer problems.

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Appendix

Table A-1: Goodness of Fit Indices for Latent Profile Analysis

	Classes	Parameters	LL	AIC	BIC	CAIC	ssBIC	Entropy
Peer Acceptance Full Sample (n=438)	1	14	-1922.64	3873.29	3930.44	3944.44	3886.01	NA
	2	29	-1829.05	3716.09	3834.48	3863.48	3742.44	0.746
	3	44	-1778.22	3644.44	3824.06	3868.06	3684.43	0.697
	4*	59	-1751.00	3619.99	3860.84	3919.84	3673.60	0.752
Peer Problems Full Sample (n=438)	1	14	-2185.98	4399.95	4457.11	4471.11	4412.68	NA
	2	29	-1957.30	3972.60	4090.98	4119.98	3998.95	0.749
	3 [‡]	-	-	-	-	-	-	-
	4 [†]	59	-1841.86	3801.72	4042.57	4101.57	3855.33	0.738
Friendships Full Sample (n=438)	1	9	-1158.33	2334.67	2371.41	2380.41	2342.84	NA
	2	19	-972.14	1982.29	2059.85	2078.85	1999.55	0.799
	3	29	-884.04	1826.08	1944.47	1973.47	1852.44	0.768
	4*	39	-841.30	1760.61	1919.81	1958.81	1796.05	0.732
Peer Acceptance VP/VLBW (n=218)	1	14	-975.45	1978.91	2026.29	2040.29	1981.93	NA
	2	29	-926.02	1910.03	2008.18	2037.18	1916.29	0.822
	3	44	-897.38	1882.77	2031.68	2075.68	1892.25	0.764
	4* [†]	59	-867.10	1852.19	2051.88	2110.88	1864.91	0.853
Peer Acceptance Term-Born (n=220)	1	14	-917.86	1863.72	1911.23	1925.23	1866.87	NA
	2	29	-866.97	1791.94	1890.35	1919.35	1798.45	0.788
	3	44	-830.22	1748.43	1897.75	1941.75	1758.32	0.780
	4* [^]	59	-805.83	1729.65	1929.87	1988.87	1742.90	0.817
Peer Problems VP/VLBW (n=218)	1	14	-1148.73	2325.46	2372.84	2386.84	2328.48	NA
	2	29	-1042.34	2142.68	2240.83	2269.83	2148.93	0.725
	3	44	-1001.18	2090.35	2239.27	2283.27	2099.84	0.810
	4	59	-969.14	2056.27	2255.96	2314.96	2068.99	0.824
Peer Problems Term-Born (n=220)	1	14	-981.55	1991.09	2038.60	2052.60	1994.24	NA
	2	29	-845.02	1748.05	1846.46	1875.46	1754.56	0.823
	3	44	-801.13	1690.26	1839.58	1883.58	1700.15	0.849
	4 [†]	59	-777.75	1673.49	1873.72	1932.72	1686.74	0.871
Friendships VP/VLBW (n=218)	1	9	-633.08	1284.16	1314.62	1323.62	1286.10	NA
	2	19	-547.06	1132.13	1196.43	1215.43	1136.22	0.808
	3	29	-493.48	1044.95	1143.10	1172.10	1051.21	0.783
	4 [†]	39	-475.60	1029.20	1161.20	1200.20	1037.61	0.822
Friendships Term-Born (n=220)	1	9	-467.28	952.57	983.11	992.11	954.59	NA
	2	19	-367.80	773.60	838.08	857.08	777.87	0.803
	3	29	-337.18	732.36	830.77	859.77	738.87	0.754
	4	39	-316.52	711.04	843.39	882.39	719.80	0.792

Note. Shading represents model was excluded due to estimation errors; [†]Solution may not be trustworthy due to local maxima

[^]Model non-identification error; [‡]Estimated covariance matrix could not be inverted; *4th class is small, does not contribute to interpretability.

Table A-2: Multinomial Logistic Regression Results for Variables Predicting Peer Acceptance Trajectory in the Full Sample (n= 438)

	Variable	<i>B</i>	SE <i>B</i>	Wald	df	OR	95% CI
Low peer acceptance	Intercept	2.69*	1.18	5.15	1		
	VP/VLBW	0.00	0.56	0.00	1	1.00	0.34 – 2.97
	Sex (male)	-0.07	0.22	0.09	1	0.94	0.61 – 1.44
	Lower SES	-0.02	0.07	0.10	1	0.98	0.84 – 1.13
	Neonatal medical risk	-0.01	0.06	0.06	1	0.99	0.88 – 1.11
	Good PIRI	-0.12	0.23	0.26	1	0.89	0.56 – 1.41
	Good inhibitory control	0.08	0.24	0.12	1	1.08	0.67 – 1.75
	Cognitive abilities	-0.03*	0.01	5.91	1	0.97	0.95 – 0.99
Improving peer acceptance	Intercept	1.24	1.60	0.60	1		
	VP/VLBW	0.44	0.73	0.37	1	1.55	0.38 – 6.44
	Sex (male)	-0.50	0.30	2.91	1	0.60	0.34 – 1.08
	Lower SES	-0.01	0.10	0.02	1	0.99	0.82 – 1.20
	Neonatal medical risk	0.08	0.08	0.90	1	1.08	0.92 – 1.27
	Good PIRI	0.03	0.31	0.01	1	1.03	0.56 – 1.90
	Good inhibitory control	0.14	0.32	0.18	1	1.15	0.61 – 2.14
	Cognitive abilities	-0.02	0.01	1.60	1	0.98	0.96 – 1.01
<i>LR</i> χ^2		16.80					

Note: * $p < .05$. The reference category is Average peer acceptance trajectory.

Table A-3: Binary Logistic Regression for Variables Predicting Low Peer Problems Trajectory in the Full Sample (n= 438)

Variable	<i>B</i>	SE <i>B</i>	Wald	df	OR	95% CI
Constant	-6.37***	1.48	18.63	1	0.00	
VP/VLBW	0.23	0.53	0.19	1	1.26	0.44 – 3.55
Sex (female)	0.30	0.21	1.91	1	1.34	0.88 – 2.04
Lower SES	-0.08	0.07	1.34	1	0.92	0.80 – 1.06
Neonatal medical risk	0.04	0.06	0.55	1	1.04	0.93 – 1.17
Good PIRI	0.48*	0.23	4.43	1	1.61	1.03 – 2.50
Good inhibitory control	-0.10	0.23	0.19	1	0.90	0.57 – 1.43
Cognitive abilities	0.06***	0.01	20.63	1	1.06	1.04 – 1.09

*Note: *p < .05, ***p < .01*

Table A-4: Multinomial Logistic Regression Results for Variables Predicting Friendship Trajectory in the Full Sample (n= 438)

	Variable	<i>B</i>	<i>SE B</i>	Wald	df	OR	95% CI
Low friendships	Intercept	-1.20	1.37	0.77	1		
	VP/VLBW	0.30	0.96	0.10	1	1.35	0.21 – 8.87
	Sex (male)	0.60	0.41	2.16	1	1.81	0.82 – 4.01
	Lower SES	0.04	0.13	0.09	1	1.04	0.80 – 1.35
	Neonatal medical risk	-0.03	0.10	0.13	1	0.97	0.80 – 1.17
	Good PIRI	-0.30	0.40	0.58	1	0.74	0.34 – 1.62
	Good inhibitory control	0.32	0.45	0.51	1	1.38	0.57 – 3.34
	Cognitive abilities	-0.02	0.01	1.85	1	0.98	0.96 – 1.01
High friendships	Intercept	-3.42**	1.32	6.71	1		
	VP/VLBW	-0.19	0.55	0.11	1	0.83	0.28 – 2.45
	Sex (male)	-0.32	0.22	2.18	1	0.73	0.47 – 1.11
	Lower SES	0.13	0.07	3.28	1	1.14	0.99 – 1.32
	Neonatal medical risk	0.00	0.06	0.00	1	1.00	0.89 – 1.13
	Good PIRI	0.16	0.23	0.49	1	1.18	0.75 – 1.86
	Good inhibitory control	-0.07	0.24	0.10	1	0.92	0.58 – 1.48
	Cognitive abilities	0.03*	0.01	4.70	1	1.03	1.00 – 1.05
<i>LR</i> χ^2		30.28**					

Note: * $p < .05$, ** $p < .01$. The reference category is Average friendships trajectory.

Table A-5: Multinomial Logistic Regression Results for Variables Predicting Peer Acceptance Trajectory in the VP/VLBW Subgroup (n=218)

	Variable	<i>B</i>	SE <i>B</i>	Wald	df	OR	95% CI
Low peer acceptance	Intercept	-0.40	1.46	0.08	1		
	Sex (male)	0.59	0.36	2.68	1	1.81	0.89 – 3.67
	Lower SES	0.10	0.13	0.60	1	1.10	0.86 – 1.41
	Neonatal medical risk	-0.09	0.07	1.77	1	0.91	0.80 – 1.05
	Good PIRI	-0.17	0.37	0.22	1	0.84	0.41 – 1.74
	Good inhibitory control	0.62	0.52	1.43	1	1.86	0.67 – 5.16
	Cognitive abilities	-0.00	0.01	0.11	1	1.00	0.98 – 1.02
High peer acceptance	Intercept	-8.12**	2.72	8.91	1		
	Sex (male)	-0.18	0.44	0.17	1	0.83	0.35 – 1.97
	Lower SES	-0.02	0.15	0.02	1	0.98	0.73 – 1.31
	Neonatal medical risk	-0.08	0.08	0.95	1	0.92	0.78 – 1.09
	Good PIRI	0.07	0.46	0.02	1	1.07	0.44 – 2.61
	Good inhibitory control	0.59	0.58	1.03	1	1.80	0.58 – 5.56
	Cognitive abilities	0.07**	0.02	9.61	1	1.08	1.03 – 1.13
<i>LR</i> χ^2		30.32**					

Note: ** $p < .01$. The reference category is Average peer acceptance trajectory.

Table A-6: Multinomial Logistic Regression Results for Variables Predicting Peer Acceptance Trajectory in the Term-born Subgroup (n=220)

	Variable	<i>B</i>	SE <i>B</i>	Wald	df	OR	95% CI
Low peer acceptance	Intercept	-2.30	2.98	0.60	1		
	Sex (male)	-0.35	0.35	1.01	1	0.70	0.36 – 1.40
	Lower SES	-0.05	0.11	0.16	1	0.96	0.77 – 1.19
	Neonatal medical risk	-0.09	0.27	0.10	1	0.92	0.54 – 1.55
	Good PIRI	0.04	0.39	0.01	1	1.04	0.49 – 2.22
	Good inhibitory control	-0.30	0.35	0.75	1	0.74	0.38 – 1.46
	Cognitive abilities	0.03	0.03	1.30	1	1.03	0.98 – 1.09
High peer acceptance	Intercept	-1.23	3.42	0.13	1		
	Sex (male)	-0.84*	0.41	4.25	1	0.43	0.20 – 0.96
	Lower SES	0.18	0.13	1.95	1	1.20	0.93 – 1.55
	Neonatal medical risk	-0.11	0.30	0.12	1	0.90	0.50 – 1.63
	Good PIRI	-0.10	0.43	0.05	1	0.91	0.39 – 2.11
	Good inhibitory control	-0.48	0.40	1.47	1	0.62	0.28 – 1.35
	Cognitive abilities	0.01	0.03	0.16	1	1.01	0.95 – 1.08
<i>LR</i> χ^2		12.29					

Note: * $p < .05$. The reference category is Average peer acceptance trajectory.

Table A-7: Multinomial Logistic Regression for Variables Predicting Low Peer Problems Trajectory in the VP/VLBW Subgroup (n=218)

	Variable	<i>B</i>	SE <i>B</i>	Wald	df	OR	95% CI
Low, increasing peer problems	Intercept	9.05***	2.63	11.97	1		
	Sex (male)	0.44	0.41	1.20	1	1.56	0.70 – 3.45
	Lower SES	0.04	0.14	0.09	1	1.04	0.79 – 1.38
	Neonatal medical risk	-0.07	0.08	0.73	1	0.94	0.80 – 1.09
	Good PIRI	-0.57	0.42	1.83	1	0.57	0.25 – 1.29
	Good inhibitory control	0.63	0.50	1.58	1	1.87	0.70 – 4.96
	Cognitive abilities	-0.10***	0.02	21.03	1	0.90	0.86 – 0.94
High, decreasing peer problems	Intercept	5.24*	2.66	3.90	1		
	Sex (male)	-0.06	0.40	0.03	1	0.94	0.43 – 2.07
	Lower SES	0.04	0.14	0.07	1	1.04	0.79 – 1.37
	Neonatal medical risk	-0.00	0.08	0.00	1	1.00	0.86 – 1.16
	Good PIRI	-0.34	0.43	0.62	1	0.72	0.31 – 1.65
	Good inhibitory control	0.65	0.49	1.75	1	1.91	0.73 – 4.95
	Cognitive abilities	-0.06*	0.02	6.19	1	0.94	0.90 – 0.99
Highest peer problems	Intercept	11.35***	2.82	16.16	1		
	Sex (male)	1.09*	0.54	4.18	1	2.99	1.05 – 8.52
	Lower SES	-0.16	0.18	0.76	1	0.86	0.60 – 1.22
	Neonatal medical risk	0.05	0.10	0.21	1	1.05	0.86 – 1.28
	Good PIRI	-2.03***	0.57	12.89	1	0.13	0.04 – 0.40
	Good inhibitory control	0.08	0.75	0.01	1	1.09	0.25 – 4.70
	Cognitive abilities	-0.11***	0.02	22.55	1	0.89	0.85 – 0.94
<i>LR</i> χ^2		67.20***					

Note: * $p < .05$, *** $p < .001$. The reference category is Lowest peer problems trajectory

Table A-8: Binary Logistic Regression for Variables Predicting Low Peer Problems Trajectory in the Term-born Subgroup (n=220)

Variable	<i>B</i>	SE <i>B</i>	Wald	df	OR	95% CI
Constant	-1.00	2.47	0.16	1	0.37	
Sex (female)	0.51	0.29	3.04	1	1.67	0.94 – 2.96
Lower SES	-0.26**	0.10	7.39	1	0.77	0.64 – 0.93
Neonatal medical risk	0.34	0.22	2.36	1	1.41	0.91 – 2.18
Good PIRI	0.35	0.32	1.20	1	1.42	0.76 – 2.67
Good inhibitory control	0.36	0.29	1.58	1	1.44	0.82 – 2.54
Cognitive abilities	0.01	0.02	0.20	1	1.01	0.97 – 1.06

*Note: ** $p < .01$.*

Table A-9: Multinomial Logistic Regression Results for Variables Predicting Friendships Trajectory in the VP/VLBW Subgroup (n=218)

Variable		<i>B</i>	SE <i>B</i>	Wald	df	OR	95% CI
Low friendships	Intercept	0.39	2.18	0.03	1		
	Sex (male)	-0.79	0.58	1.88	1	0.46	0.15 – 1.40
	Lower SES	-0.02	0.19	0.01	1	0.98	0.68 – 1.42
	Neonatal medical risk	-0.05	0.11	0.18	1	0.96	0.77 – 1.18
	Good PIRI	0.38	0.54	0.48	1	1.46	0.50 – 4.21
	Good inhibitory control	-0.47	0.66	0.51	1	0.63	0.17 – 2.26
	Cognitive abilities	0.02	0.01	1.44	1	1.02	0.99 – 1.05
High friendships	Intercept	-1.30	2.37	0.30	1		
	Sex (male)	-1.20	0.62	3.75	1	0.30	0.09 – 1.02
	Lower SES	-0.08	0.21	0.14	1	0.93	0.62 – 1.39
	Neonatal medical risk	0.01	0.12	0.01	1	1.01	0.80 – 1.27
	Good PIRI	0.67	0.59	1.29	1	1.96	0.61 – 6.28
	Good inhibitory control	-0.72	0.72	0.99	1	.49	0.12 – 2.01
	Cognitive abilities	0.04	0.02	3.75	1	1.04	1.00 – 1.07
<i>LR</i> χ^2		12.04					

Note. The reference category is Average friendships trajectory.

Table A-10: Multinomial Logistic Regression Results for Variables Predicting Friendships Trajectory in the Term-born Subgroup (n=220)

Variable		<i>B</i>	<i>SE B</i>	Wald	df	OR	95% CI
Low friendships	Intercept	-4.69	3.32	2.0	1		
	Sex (male)	-0.03	0.38	0.01	1	0.97	0.46 – 2.05
	Lower SES	-0.22	0.13	3.04	1	0.80	0.63 – 1.03
	Neonatal medical risk	0.17	0.29	0.35	1	1.19	0.67 – 2.11
	Good PIRI	-0.23	0.42	0.29	1	0.80	0.35 – 1.81
	Good inhibitory control	0.29	0.38	0.58	1	1.33	0.64 – 2.80
	Cognitive abilities	0.05	0.03	2.32	1	1.05	0.99 – 1.11
High friendships	Intercept	-3.44	2.82	1.49	1		
	Sex (male)	-0.26	0.33	0.64	1	0.77	0.40 – 1.46
	Lower SES	0.21	0.11	3.67	1	1.23	1.00 – 1.52
	Neonatal medical risk	-0.02	0.24	0.00	1	0.98	0.61 – 1.58
	Good PIRI	0.05	0.36	0.02	1	1.05	0.52 – 2.13
	Good inhibitory control	0.07	0.32	0.05	1	1.08	0.57 – 2.03
	Cognitive abilities	0.03	0.03	1.15	1	1.03	0.98 – 1.08
<i>LR χ^2</i>		17.89					

Note. The reference category is Average friendships trajectory.

Table A-11: Neonatal Medical Risk Score

Description
Data on neonatal medical complications was collected prospectively and summarized into a comprehensive index score, ranging from 0 (best state) to 21 (worst state), based on the following items:
1. ventilation or intubation
2. Apgar at 1 min after birth <9 and at 5 min after birth <10
3. buffering and/or volume substitution
4. cord artery pH ≥ 7.3
5. outborn (i.e. infants were transported after birth from outside obstetric units for neonatal care)
6. body temperature $\leq 36^{\circ}\text{C}$
7. artificial aspiration
8. apnoea/bradycardia
9. ventilation disorder
10. hypoglycaemia
11. heart failure
12. hyperbilirubinaemia
13. other metabolic diseases
14. severe anaemia
15. sepsis
16. operation
17. deficits in development (i.e. neurodevelopmental problems)
18. medication > one time/day
19. nasogastric feeding
20. neonatal seizures
21. cerebral haemorrhage (on ultrasound examination neonatally)

Table A-12: Parent-Infant Relationship Index (PIRI)

Description	Coding
Standardized interview with parents and research nurses' observations of attachment-related parental concerns, feelings, and behavior. All research nurses were trained in advance, but inter-rater agreement was not assessed. The scale comprised 8 items of yes (1) or no (0) ratings on the following items: 1. mother does not yet know the infant (mother interview, neonatal), 2. mother visits infant once a week or less (mother interview, neonatal), 3. father visits infant less than once a week (mother or father interview, neonatal), 4. mother is insecure when taking care of child at home (mother interview, neonatal), 5. mother shows little pleasure when interacting with child (nurse observation, neonatal), 6. father shows little pleasure when interacting with child (nurse observation, neonatal), 7. the probability that these parents develop problems in taking care of infant is high (nurse observation, neonatal), 8. mother has trouble building a relationship with child (pediatrician rating after mother interview at 5 months of age).	PIRI (0) no concerns for the parent–infant relationship (1) some degree of concern for the parent–infant relationship
First, a sum score was calculated by adding one point for each 'yes' answer. Since the resulting sum score did not show a normal distribution as most parents reported and demonstrated a good relationship with their infant, the sum score was recoded into “no concerns for the parent–infant relationship” (score 0; 52.0%) and “some degree of concern for the parent–infant relationship” (score 1-8; 48.0%).	

Table A-13: Summary Description of Peer Relationship Domain Scores by Assessment Age

	6 years	8 years	13 years	26 years
Peer Problems	Parent answered the following six items from the CBCL ^{1,2} , social problems subscale:	Parent answered the following six items from the CBCL ^{1,2} , social problems subscale:	Parents and individuals answered parallel versions of the following three items from the SDQ ^{3,4} :	Individuals answered the following six items from the YASR ⁵ , social problems subscale:
Presence of conflict or negative experiences in social situations	- Acts too young for his/her age - Clings to adults or too dependent - Doesn't get along with other kids - Gets teased a lot - Not liked by other kids - Prefers being with younger kids Responses were recoded to 1= not true, 2= somewhat true/sometimes, 3= very true/often. Responses on the six items were averaged, then z-standardized into a Peer problems z-score.	- Acts too young for his/her age - Clings to adults or too dependent - Doesn't get along with other kids - Gets teased a lot - Not liked by other kids - Prefers being with younger kids Responses were recoded to 1= not true, 2= somewhat true/sometimes, 3= very true/often. Responses on the six items were averaged, then z-standardized into a Peer problems z-score.	- Tends to be a loner - Is bullied by other children - Gets on better with adults than other children his/her age Responses were recoded to 1= not true, 2= somewhat true, 3= certainly true. Parent responses were averaged into a parent index score, then z-standardized. Individual responses were averaged into an individual index score then z-standardized. The parent and individual index scores were then averaged into a Peer problems z-score.	- I act too young for my age - I am too dependent on others - I do not get along with other people - I get teased a lot - I am not liked by others - I would rather be with younger people than with people of my own age Responses were recoded to 1= not true, 2= somewhat true/sometimes, 3= very true/often. Responses on the six items were averaged, then z-standardized into a Peer problems z-score.

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2. Döpfner, M., Schmeck, K., Berner, W., Lehmkuhl, G., & Poustka, F. (1994). Zur Reliabilität und faktoriellen Validität der Child Behavior Checklist—eine Analyse in einer klinischen und einer Feldstichprobe. *Zeitschrift für Kinder-und Jugendpsychiatrie und Psychotherapie*.
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5. Achenbach, T. M. (1997). *Manual for the Young Adult Self-Report and Young Adult Behavior Checklist*. Department of Psychiatry, University of Vermont; Burlington, VT.

Table A-13 (Continued)

	6 years	8 years	13 years	26 years
Peer Acceptance Popularity, status in the peer group	Parent and individual answered parallel versions of the following six items from the Pictorial Scale of Perceived Competence and Social Acceptance for Young Children ^{6,7} : - Has friends to play with - Stays overnight at his/her friends' houses - Has friends to play games with - Has friends on the playground - Other children ask if child wants to play - Eats at friends' houses Responses were coded on a 4-point scale with greater values indicating higher acceptance. Parent responses were averaged and z-standardized into parent index score. Child responses were also averaged and z-standardized into child index score. Parent and child index scores were then averaged together into Peer acceptance z-score.	Parent and individual answered parallel versions of the following six items from the Pictorial Scale of Perceived Competence and Social Acceptance for Young Children ^{6,7} : - Has friends to play with - Stays overnight at his/her friends' houses - Has friends to play games with - Has friends on the playground - Other children ask if child wants to play - Eats at friends' houses Responses were coded on a 4-point scale with greater values indicating higher acceptance. Parent responses were averaged and z-standardized into parent index score. Child responses were also averaged and z-standardized into child index score. Parent and child index scores were then averaged together into Peer acceptance z-score.	Individual rated him/herself on a scale (adapted from Nicholls' self-concept of attainment ⁸) from 1-25 on the following four items: - I make friends very easily - I have many friends - I am very popular with other children - Other children like me very much Responses to the four items were averaged and z-standardized into a Peer acceptance z-score.	Individual rated him/herself on a scale (adapted from Nicholls' self-concept of attainment ⁸) from 1-25 on the following two items: - I make friends easily - I am very popular with others Responses to the two items were averaged and z-standardized into a Peer acceptance z-score.

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Table A-13 (Continued)

	6 years	8 years	13 years	26 years
Friendships	1. <u>Number friends score</u> ^{9,10} A. Parent listed up to 8 friends, z-standardized B. Individual listed up to 10 friends, z-standardized A and B were averaged	1. <u>Number friends score</u> ^{9,10} A. Parent listed up to 8 friends, z-standardized B. Individual listed up to 10 friends, z-standardized A and B were averaged	1. <u>Number friends score</u> ⁸ A. Individual rated self on a scale from 1-25 on the item “I have many friends”, z-standardized	1. <u>Number friends score</u> A. Individual reported his/her number of friends (1= 0 friends, 2= 1 or 2 friends, 3= 3-4 friends, 4= more than 4 friends), z-standardized
	2. <u>Best friend score</u> ^{9,10} C. Parent was asked if child has a best friend (yes/no) D. Child was asked if he/she has a best friend (yes/no) C and D were recoded to 1= no and 2= yes, then z-standardized and averaged 1 and 2 were then averaged into Friendships z-score	2. <u>Best friend score</u> ^{9,10} C. Parent was asked if child has a best friend (yes/no) D. Child was asked if he/she has a best friend (yes/no) C and D were recoded to 1= no and 2= yes, then z-standardized and averaged 1 and 2 were then averaged into Friendships z-score	2. <u>Good friend score</u> ^{5,6} B. Parent reported whether child has at least one good friend C. Individual reported whether he/she has at least one good friend B and C were recoded to 1= not true 2= somewhat true, 3= certainly true z-standardized, then averaged 1 and 2 were then averaged into Friendships z-score	2. <u>Good friend score</u> B. Individual reported whether he/she has at least one good friend (1= no, 2= yes), z-standardized A and B were averaged into Friendships z-score

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Vita

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