Behavioural Difficulties in Early Childhood: Findings from a Longitudinal Birth Cohort

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Abstract

Targeting behavioural problems in early childhood may be important for the prevention of later adverse outcomes. However, there is evidence that behavioural difficulties may not remain stable during this period. This thesis was interested in investigating the development and stability in behavioural problems during early childhood, focusing on how the family context plays a role in influencing these difficulties. Using the *Growing Up in New Zealand* birth cohort, behavioural problems were assessed when children were 2 years and 4.5 years using the preschool and standard parent-rated Strengths and Difficulties Questionnaire (SDQ), respectively.

This thesis firstly investigated whether the SDQ was an acceptable measure of behaviour at 2 years. In addition, the current thesis evaluated whether behavioural difficulties remained stable from 2 to 4.5 years. Guided by Bronfenbrenner's (1979) bioecological model and focusing specifically on the family context, the predictors of early childhood behavioural difficulties were assessed. Preschool cognitive delays associated with the development and persistence of early childhood behavioural difficulties were also evaluated.

The results revealed that the SDQ was a generally acceptable measure of behavioural difficulties in 2 year old children. Further, it was demonstrated that behavioural problems were not stable during the early childhood period, as the majority of children who showed behavioural difficulties at age 2 improved at 4.5 years. It was found that children who developed behavioural problems between 2 to 4.5 years and children who showed persistent difficulties were at an increased risk of delays in language and executive control. Investigation into risk factors indicated that maternal

mental health at multiple time points was associated with the development and persistence of early childhood behavioural difficulties. Parenting factors, such as maternal self-evaluation and harsh parenting styles were also related to the development and stability of early childhood behavioural problems. Distal factors linked to early childhood behaviour included verbal and physical inter-parental conflict, as well as family social support.

Overall, the current thesis has several implications for initiatives targeting behavioural problems in early childhood. Most notably, this thesis suggests that a multisystem, family-centred approach is important for targeting behavioural problems during early childhood.

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1. General Introduction

1.1. Why study behavioural difficulties in early childhood?

There has been a growing interest in the investigation of psychopathology and behavioural problems[1] in early childhood, as there is increasing evidence that psychiatric disorders may have their onset in childhood (Egger & Angold, 2006; Ezpeleta, Osa, & Doménech, 2013; Odgers et al., 2007; Poulou, 2013). In her review of early childhood behavioural difficulties, Poulou (2013) noted that several studies have linked behavioural problems in early childhood to an increased likelihood of showing psychiatric disorders at a later age. Additionally, several studies have shown that children who show behavioural problems at school-age are also at an increased risk of developing psychiatric difficulties in adulthood. For example, Fergusson, Horwood and Ridder (2005) found that serious childhood conduct problems were associated with greater rates of adulthood depression and anxiety, antisocial personality, and suicide attempts in the Christchurch Health and Development Study. Within the same cohort, Jakobsen, Horwood and Fergusson (2012) found that internalising symptoms such as anxiety and withdrawal in childhood were associated with an increased risk of anxiety and depression in adulthood. Furthermore, research from the Avon Longitudinal Study of Parents and Children has linked attention-deficit/hyperactivity disorder (ADHD), hyperactivity, conduct and peer

[1] In this thesis, behavioural problems, also referred to as behavioural difficulties, are defined as either a diagnosis with an emotional or behavioural disorder, or scoring within a clinically-significant range on measures of internalising, externalising or social behavior.

problems in childhood to symptoms of bipolar disorder in adulthood (Mistry, Zammit, Price, Jones, & Smith, 2017).

Importantly, the long term outcomes of early childhood behavioural problems are not solely limited to mental health challenges in adulthood. Fergusson et al. (2005) also found that childhood conduct problems were associated with greater rates of crime, including violent offending, arrest or convictions, and imprisonment; greater substance dependence; and adverse sexual or partner relationships, including teenage pregnancy and domestic violence. Similar results have also been observed with the Dunedin Multidisciplinary Health and Development Study; males and females on a life-course persistent trajectory in antisocial behaviour with an onset in childhood showed a high level of continuity in antisocial behaviour, as well as greater mental health and substance dependency challenges, increased economic hardship, and greater violent behaviour as adults (Moffitt, Caspi, Harrington, & Milne, 2002; Odgers et al., 2008).

Further, early behavioural problems, primarily hyperactivity, have also been linked to poorer performance and difficulties at school in both the Dunedin Multidisciplinary Health and Development Study and the Australian Temperament Project (McGee, Prior, Williams, Smart, & Sanson, 2002). While these studies primarily focus on school-age children, the fact that preschool behavioural difficulties predict school-age behavioural problems (Lavigne et al., 1998; Mesman & Koot, 2001) suggests that early childhood may be an important period to target or the prevention of later adverse outcomes. In support of this, research has indicated that early intervention or prevention programmes may help in reducing serious behavioural problems, and even

prevent its continuity into later in life (Nelson, Westhues, & MacLeod, 2003; Poulou, 2013).

1.2. Stability of behavioural difficulties in early childhood

While the research discussed in Section 1.1 implies that preschool behavioural problems may show relative stability over the life course, there is some evidence to suggest that not all children who show early behavioural problems persist in these difficulties. In a study by Mathiesen and Sanson (2000), social, internalising and externalising behavioural problems were assessed in a Norwegian community sample when children were aged 18 months and 30 months; children were then categorised as showing either problematic or non-problematic behaviour at each time point. While the prevalence in behavioural problems did not vary greatly between the two time points, the authors found that only 37% of children with behavioural problems at 18 months persisted in their difficulties at 30 months. This suggests that a considerable proportion of children who initially show behavioural problems improve over the early childhood period.

In addition, it appears that continuity in problem behaviour over the preschool period is heterotypic in nature. In two separate studies assessing behavioural problems at 3 and 6 years, one using DSM-IV diagnoses (Bufferd, Dougherty, Carlson, Rose, & Klein, 2012) and the other using the Child Behaviour Checklist (CBCL) (Basten et al., 2016), results indicated that children who showed a continuity in behavioural problems from 3 to 6 years did not necessarily present with the same type of behavioural problem at both time points. However, research on the stability of behavioural problems in early childhood is limited. Given the long term implications of early childhood behavioural

problems, highlighted above, determining whether these problems are persistent is important in informing efforts that address behavioural problems during this period.

1.3. Predictors of behavioural problems in early childhood

1.3.1. Theoretical framework

Bronfenbrenner's (1979) bioecological model offers a framework that accounts for the multiple environmental systems that an individual is embedded within which may influence their development. This is conceptualised in Figure 1.1. Briefly, these systems include a microsystem, which consists of the child's immediate environment (e.g. family, peers, school); a mesosystem, which involves the interactions between microsystems (e.g. inter-parental relationships, interactions between teachers and family); an exosystem, which consists of links between social settings that the child is not actively within, but that may still influence the child's development (parents' social networks and workplaces); the macrosystem, which describes the broader sociocultural context of the individual and their micro-, meso-, and exosystems (e.g. SES, ethnicity); and finally the chronosystem, which describes the patterning of individual transitions and environmental changes over the life course, as well as the sociohistorical context.

During early childhood, the microsystem of a child primarily consists of their immediate family. As such, the microsystem, mesosystem and exosystem are also likely revolve around the family context during this early period. Nau and Heckert (2013) elaborate on this concept in greater detail. The authors noted that factors within the microsystem that may influence children's behavioural development can occur as early as the gestational period. In addition, they discuss how family processes are important when considering development. These family processes can occur within the microsystem (e.g.

parenting behaviours), involve the mesosystem (e.g. inter-parental conflict), as well as the exosystem (social support available to the family). These factors and their link to child behavioural problems are elaborated below. It is important to note that the literature review that follows focuses on studies that include primarily preschool-age children from large community-based samples or longitudinal cohorts. While there are clinical studies contributing to this area of research, the results from these studies may not apply to the general population. This is particularly of concern in the New Zealand (NZ) population, where there may be biases in access to healthcare (Brabyn & Barnett, 2004; Jatrana & Crampton, 2009; Pearce, Witten, & Bartie, 2006).

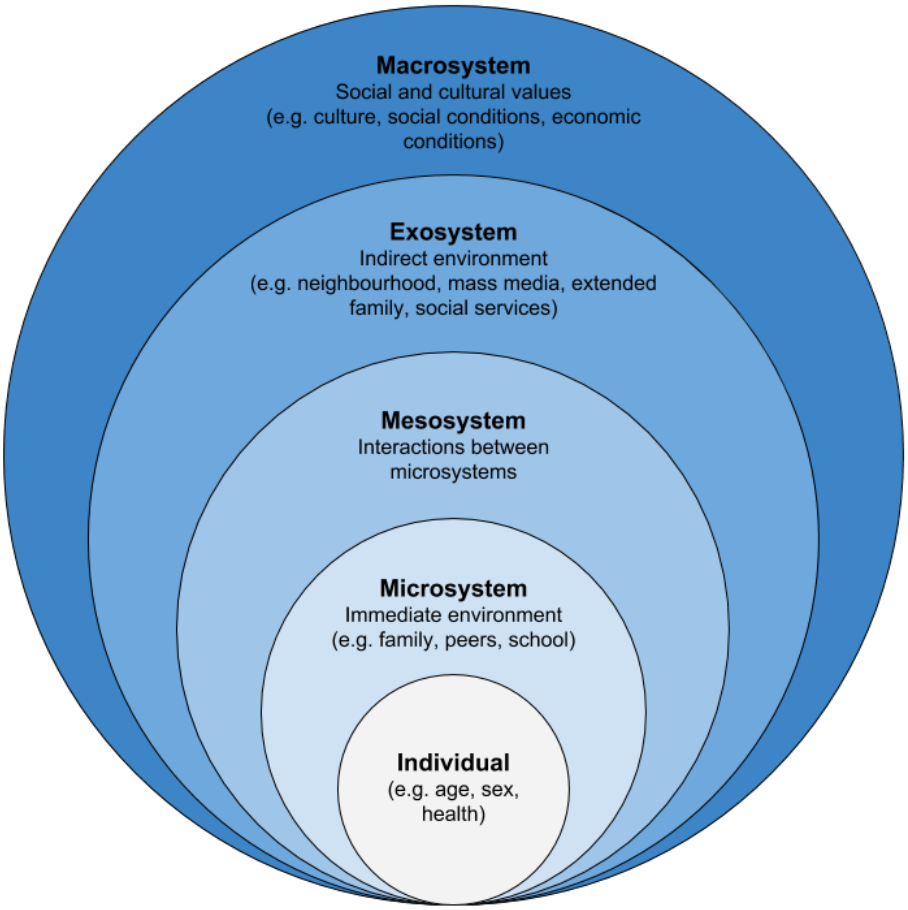

Figure 1.1. The ecological systems relating to Bronfenbrenner's (1979) bioecological model.

1.3.2. The perinatal period

As previously mentioned, Nau and Heckert (2013) noted that in utero biological processes are important for child development. Specifically, they refer to the foetal origins or foetal programming theory (D. J. Barker, 1998), which postulates that in utero exposure to certain nutrients and chemicals during critical periods can affect later physical, cognitive and psychological development through epigenetic processes (T. C. Williams & Drake, 2015). In relation to childhood behavioural problems, there is substantial research on the potential influence of teratogenic exposure during pregnancy, specifically alcohol and nicotine. Behavioural dysfunction has been reported in individuals with foetal alcohol spectrum disorder (FASD), namely behavioural, social and attentional problems (Kodituwakku, 2007). However, studies that have been conducted with community samples show mixed results. For example, Sood et al. (2001) found that low levels of daily prenatal alcohol consumption was associated with higher scores on the CBCL in 6 to 7 years olds, whereas Robinson et al. (2010) found that low levels of weekly prenatal alcohol consumption was associated with *lower* CBCL scores over 2 to 14 years of age, with no effect of heavier alcohol consumption. Further, a review by Linnet et al. (2003), found that only 4 out 9 studies found a significant association between prenatal alcohol consumption and ADHD.

The review by Linnet et al. (2003) and a review of broader behavioural problems by Huizink and Mulder (2006) have both noted that several studies have found an association between prenatal nicotine exposure and subsequent ADHD or behavioural problems. However, there has been some evidence that factors such as parental sociodemographics and mental health may underlie this association (Knopik, 2009; Roza

et al., 2009). For example, Roza et al. found that the association between smoking during pregnancy and behavioural problems at 18 months was accounted for by nationality, parental socioeconomic status (SES) and parental mental health. Roza et al. also found that paternal smoking was associated with behavioural problems with children, which is consistent with other research linking second hand smoke exposure and early behavioural problems (Downey et al., 2015). Therefore, when evaluating the association between maternal smoking during pregnancy and child behavioural difficulties, it is also important to consider the possible effects of sociodemographic factors and second hand smoke exposure.

Aside from the potential influence of prenatal exposure to teratogens, factors such as vitamin intake during pregnancy have also been linked to behaviour in children. Folate, or folic acid, in particular is crucial for foetal development, due to its key role in neurogenesis, neurotransmitter synthesis, and the development of the central nervous system (Roza et al., 2010). While it is generally well known that the intake of folic acid supplements prior to conception and in the first trimester is important for the prevention of neural tube defects (R. D. Wilson et al., 2015), there is also evidence that appropriate intake of folic acid supplements reduces the risk of behavioural symptoms in childhood (Roza et al., 2010; Schlotz et al., 2010; Steenweg–de Graaff et al., 2012). It is hypothesized that this association may be due to programming effects that inadequate folic acid intake has on foetal brain development (Craciunescu et al., 2004; Roza et al., 2010; Xiao et al., 2005).

While not explicitly related to the prenatal period, breastfeeding is also a factor that is important for healthy neurodevelopment in children. It is hypothesised that the

nutrients from breastmilk as well as the interactive bonding experience of breastfeeding between mother and child contribute positively to neurological development, which may have flow on effects on the child's behavioural regulation (Heikkila, Sacker, Kelly, Renfrew, & Quigley, 2011). In support of this hypothesis, Oddy et al. (2010) observed that children breastfed for a minimum of 6 months obtained lower scores on measures of behavioural problems from the ages of 2 to 14 years.

1.3.3. Maternal mental health

Nau and Heckert (2013) did not substantially discuss the role of maternal mental health in influencing children's health and wellbeing. However, there is considerable research on the association between maternal mental health, specifically depression and anxiety or stress, and child behavioural problems (Glasheen, Richardson, & Fabio, 2010; S. H. Goodman et al., 2011; Huizink, Mulder, & Buitelaar, 2004; Stein et al., 2014; B. R. H. Van den Bergh, Mulder, Mennes, & Glover, 2005). Several review articles have reported on the link between maternal prenatal stress and depression and subsequent behavioural problems later in development (Charil, Laplante, Vaillancourt, & King, 2010; Field, 2011; Huizink et al., 2004; B. R. H. Van den Bergh et al., 2005). Consistent with the foetal origins theory discussed above, it is hypothesised that neurochemical correlates of prenatal stress and depression, such as increased maternal cortisol levels, can have programming effects on the developing foetus, resulting in potential long term consequences for the child's health and development (Charil et al., 2010; Field, 2011).

Evidence is mixed in relation to postnatal depression in mothers. While researchers have found that postnatal depression in the mother was associated with increased behavioural problems in children during early childhood (Avan, Richter,

Ramchandani, Norris, & Stein, 2010; Pemberton et al., 2010), middle childhood (E. D. Barker, Jaffee, Uher, & Maughan, 2011) and adolescence (Korhonen, Luoma, Salmelin, & Tamminen, 2012), there is also evidence to indicate that recurrent or ongoing depression may underlie the association between postnatal depression and behavioural problems (Fihrer, McMahon, & Taylor, 2009; Grace, Evindar, & Stewart, 2003; Josefsson & Sydsjö, 2007).

With regard to the association between postnatal maternal anxiety and child behaviour, research is relatively limited as most studies appear to primarily focus on temperamental outcomes in children rather than behaviour (Glasheen et al., 2010). However, researchers that have explicitly looked at behavioural problems in early childhood have generally found significant associations with maternal postnatal anxiety (Barnett, Schaafsma, Guzman, & Parker, 1991; O'Connor, Heron, Golding, Beveridge, & Glover, 2002; O'Connor, Heron, Golding, Glover, & the AL SPAC Study Team, 2003).

1.3.4. Family processes

Nau and Heckert (2013) also noted the importance of considering family processes, and how these may influence the child's health and wellbeing; for example, they discuss how family relationships, such as the parent-child relationship and inter-parental relationship, may influence the mental health of the developing child. Within the literature, several studies, some of which will be discussed below, have supported this idea.

In relation to the parent-child relationship, parenting behaviour appears to be important for the developing child. For example, the use of physical punishment in parenting and an authoritarian parenting style have both been associated with behavioural

problems in childhood and adolescence (Alizadeh, Abu Talib, Abdullah, & Mansor, 2011; MacKenzie, Nicklas, Waldfogel, & Brooks-Gunn, 2012; C. A. Taylor, Manganello, Lee, & Rice, 2010). In contrast, an authoritative parenting style, which is high in warmth relative to authoritarian parenting, may be protective against the development of behavioural difficulties (Alizadeh et al., 2011; Kritzas & Grobler, 2005). Furthermore, mother's evaluation of themselves as a parent, sometimes referred to as perceived self-efficacy or self-evaluation, may also be associated with positive behavioural outcomes in children (Coleman & Karraker, 2003). This association has been found with toddlers (Coleman & Karraker, 2003) as well as older children and adolescents (Johnston & Mash, 1989; Jones & Prinz, 2005)

Research with preschool-aged children has also linked both verbal and physical conflict between parents to behavioural and adjustment problems in children (Bayer, Hiscock, Ukoumunne, Price, & Wake, 2008; Bayer et al., 2012; Martinez-Torteya, Anne Bogat, Von Eye, & Levendosky, 2009; McDonald, Jouriles, Briggs-Gowan, Rosenfield, & Carter, 2007). According to the emotional security theory (Davies & Cummings, 1994; Nau & Heckert, 2013), exposure to inter-parental conflict may lead to emotional insecurity and consequently poor behavioural regulation in the child. Further, investigating this association in early childhood is particularly important, as preschool-aged children are most likely to be exposed to familial conflict and violence (Fantuzzo, Boruch, Beriama, Atkins, & Marcus, 1997). Exposure to inter-parental conflict has also been associated with harsher parenting and poorer maternal mental health (C.-C. Huang, Wang, & Warrener, 2010; Levendosky, Leahy, Bogat, Davidson, & von Eye, 2006), both of which have been linked to behavioural difficulties (as discussed above).

Finally, the influence of family processes may extend beyond the inter-parental and parent-child systems. More specifically, family social support, whether in a formal capacity or consisting of friends and/or family, may also be protective against the development of behavioural difficulties, through influences on parenting and family functioning in adverse circumstances (Armstrong, Birnie-Lefcovitch, & Ungar, 2005; Black & Lobo, 2008). Indeed, it is fair to assume that families with greater support systems are better equipped to foster optimal development in the child; as such, it is also important to consider the family's interaction with external support systems when considering the development of early childhood behavioural difficulties.

1.3.5. Predictors of stability and change

The studies discussed above generally investigated predictors of behavioural problems at single time points. In contrast, there is limited research on factors associated with the persistence and change in behavioural problems at multiple time points, particularly during the early childhood period. Existing longitudinal cohort studies that have been conducted generally focus on predictors of persistent behavioural problems (Galéra et al., 2011; Mathiesen & Sanson, 2000), but do not always consider what factors may influence a change in behaviour (i.e. the later development of behavioural problems or improvement in behavioural problems).

The studies that have investigated determinants of persistent behavioural problems have generally identified maternal mental health as a significant predictor. Mathiesen and Sanson (2000) investigated several potential predictors of stability in behavioural problems from 18 months to 30 months, and found that maternal psychological problems, specifically anxiety and depression, was the only environmental

factor that predicted stability in social, internalising *and* externalising behavioural problems. Galéra et al. (2011) investigated the predictors of high trajectories in hyperactivity-impulsivity and inattention from 17 months to 6 years and, consistent with Mathiesen and Sanson's results, found that depression in mothers at 5 months (amongst other factors) was also associated with high trajectories (i.e. persistence) on both symptom measures.

However, as there is limited information on predictors of change in behavioural problems using prospective cohorts, reviewing studies on intervention or support programmes may be more informative on factors associated with improvement in behavioural difficulties. Programmes aiming to improve behavioural problems in preschool-aged children often focus on parenting practices or the quality of the parent-child relationship (Barlow, Parsons, & Stewart-Brown, 2005). Broadly, many of these programmes aim to provide the parent with the skills they need to manage and/or modify the child's behaviour, and increase responsiveness to the child (Barlow et al., 2005). According to a review by Barlow et al., there is evidence to suggest behavioural problems improve immediately following the intervention or programme, though it is unclear whether this effect is maintained long-term. Nevertheless, this implies that parenting behaviour may play a role in the improvement of behavioural problems

1.4. Comorbid difficulties of children with behavioural problems

1.4.1. Language difficulties

Efforts to address and improve behavioural problems in children need to also consider whether the child may show difficulties in other domains, such as language. This is particularly important to consider in preschool-aged children, as any intervention

or assistance targeting behavioural problems at this age needs to also ensure that the child is adequately prepared for the demands of school.

Much of the literature looking at the link between language and behavioural problems has typically focused on populations with diagnosed speech and language impairments (SLIs) (Yew & O'Kearney, 2013). However, a study by Gremillion and Martel (2014) did find that preschool-aged children with a disruptive behavioural disorder (i.e. oppositional defiant disorder or ADHD) showed lower receptive, expressive and pragmatic language abilities relative to children without any disruptive behavioural disorder. Further, in a developmental assessment of 30 month old children from Glasgow, Sim et al. (2013) found that there was substantial overlap between showing language delay and behavioural difficulties, and children with behavioural difficulties were about three times as likely to show language delay than those without behavioural difficulties.

The studies by Gremillion and Martel (2014) and Sim et al. (2013) suggest that the link between language and behavioural difficulties are not just found in populations with diagnosed SLIs. However, both studies were cross-sectional in nature, therefore more information is needed on the longitudinal association between behavioural problems and language abilities, particularly within the early childhood period. To our knowledge, only one study has longitudinally evaluated this association within a preschool population; Henrichs et al. (2013) found that vocabulary delay at 18 and 30 months was related to later behavioural problems at 36 months. However, the association between language and behaviour problems is likely bidirectional (Redmond & Rice, 1998), and the study by Henrichs et al. does not address whether earlier behavioural problems relate to subsequent language difficulties, or whether children persistent

behavioural problems are more at risk than children who only show behavioural difficulties at a single time point.

1.4.2. Cognitive challenges

In addition to language difficulties, other cognitive challenges have also been linked to behavioural problems in children, namely challenges in executive functioning. For example, Raaijmakers et al. (2008) found that preschool-aged children with high aggression showed poorer inhibition relative to children without aggression problems. Another study found that broader executive control was also significantly related to hyperactivity, attention, and disinhibition problems in early childhood (Espy, Sheffield, Wiebe, Clark, & Moehr, 2011).

However, longitudinal studies investigating the association between behavioural problems and subsequent cognitive ability during childhood are lacking, as research tends to focus more on the association between behavioural difficulties and later academic outcomes (Bulotsky-Shearer & Fantuzzo, 2011; Graziano, Reavis, Keane, & Calkins, 2007). It is also important to consider how preschool behavioural problems may relate to cognitive abilities prior to the commencement of school, given that preschool cognitive abilities are predictive of subsequent academic performance (Bull, Espy, & Wiebe, 2008; Clark, Pritchard, & Woodward, 2010; Welsh, Nix, Blair, Bierman, & Nelson, 2010). As such, the link between early behavioural difficulties and later academic outcomes may be due to children with behavioural problems showing comorbid cognitive difficulties. If so, programmes targeting preschool behavioural problems also need to consider the role of associated cognitive difficulties that the child may show.

1.5. Assessing behavioural difficulties in early childhood

1.5.1. The Strengths and Difficulties Questionnaire

The Strengths and Difficulties Questionnaire (SDQ) is a standardised instrument used to screen for behavioural problems in children and adolescents (Youth in Mind, 2014). The 25-item questionnaire was developed by Robert Goodman (1997) and produces four difficulties subscales (emotional symptoms, peer problems, hyperactivity-inattention, and conduct problems) as well as a prosocial behavior subscale, with five items corresponding to each subscale. Furthermore, the difficulties subscales can also be summed to give a measure of total difficulties. Ten of the 25 items in the questionnaire are worded positively (all five items that related to the prosocial behavior subscale, as well as five reverse-scored items relating to the difficulties subscales), with all other items worded negatively.

A standard version of the SDQ is available in parent- and teacher-report formats for children aged 4 to 17 years (R. Goodman, 1997; Youth in Mind, 2014). A self-report version has also been developed for individuals between the ages of 11 and 17 years (R. Goodman, Meltzer, & Bailey, 1998). Recently, a version with minor differences to the standard SDQ has been created for informants of preschool-aged children (Youth in Mind, 2014). The SDQ website (www.sdqinfo.com) provides normative data for several European counties, Australia, Japan, and the United States of America (USA) (Youth in Mind, 2014).

While SDQ measures can be used as continuous variables, R. Goodman (1997, 2001) notes that the subscales and total difficulties score can also be used categorically. Specifically, scores can be split into normal, borderline and abnormal bands (Youth in

Mind, 2014). The use of the categorical SDQ measures is thought to be more clinically significant, as children who score within the abnormal band would need to be referred on to the appropriate specialist for further assessment and assistance.

1.5.2. Benefits of the SDQ

The SDQ has several strengths as an instrument in research. One of its key advantages is its accessibility. The questionnaire and scoring information is free to download and utilize in paper format from the SDQ website, and available in approximately 80 different languages (Youth in Mind, 2014). In addition to its availability, the SDQ is also a brief tool relative to similar questionnaires such as the CBCL, which contains 100 items in its preschool version (Achenbach, 2001) and over 100 items in its school-age version (Achenbach, 1991). The free availability of the SDQ and its brevity make it particularly desirable for large studies, as administering longer measures such as the CBCL can be time-consuming and expensive. An added benefit of a shorter instrument is that it is also likely to increase response or completion rates (Edwards et al., 2002; Galesic & Bosnjak, 2009).

Finally, the use of the abnormal range in SDQ scores does seem to be useful in identifying clinical cases. R. Goodman, Renfrew and Mullick (2000) found that there was strong agreement between the SDQ and independent clinical diagnoses in children referred to mental health clinics in London and Bangladesh. Specifically, for any given diagnosis, the SDQ was correct in identifying the diagnosis in 81%-91% of children. Similar results were also observed in a community sample; researchers noted a specificity of 94.6% when identifying children with an independent clinical diagnosis, though the questionnaire's sensitivity was lower (63.3%) (R. Goodman, Ford, Simmons, Gatward,

& Meltzer, 2000). Finally, R. Goodman and Scott (1999) found that the SDQ was significantly better at detecting hyperactivity-inattention and as good at detecting internalizing and externalizing problems when compared to the CBCL.

1.5.3. Psychometric properties of the SDQ

The psychometric properties of the standard parent- and teacher-rated SDQ have been thoroughly examined in several different populations (Stone, Otten, Engels, Vermulst, & Janssens, 2010). Internal consistency reliability, most commonly indexed by Cronbach's alpha, was found to be moderate to good in various school-aged populations (Stone et al., 2010). It is important to note that low alpha coefficients (i.e. $\alpha < .60$) have been frequently reported for the parent-reported peer problems subscale in particular (Du, Kou, & Coghill, 2008; R. Goodman, 2001; Hawes & Dadds, 2004; Matsuishi et al., 2008; Stone et al., 2010; Van Leeuwen, Meerschaert, Bosmans, De Medts, & Braet, 2006; Woerner, Becker, & Rothenberger, 2004). However, internal consistency appears to be excellent for the parent-rated total difficulties SDQ measures, with high alpha coefficients (i.e. $\alpha > .70$) reported in many studies (Becker, Woerner, Hasselhorn, Banaschewski, & Rothenberger, 2004; R. Goodman, 2001; Hawes & Dadds, 2004; Van Roy, Veenstra, & Clench-Aas, 2008; Woerner et al., 2004).

In addition to internal consistency reliability, the factor structure of the parent-rated standard SDQ has also been investigated in several different populations, including Europe (Becker et al., 2004; R. Goodman, 2001; Van Leeuwen et al., 2006; Van Roy et al., 2008; Woerner et al., 2004), the USA (Dickey & Blumberg, 2004; He, Burstein, Schmitz, & Merikangas, 2013; Hill & Hughes, 2007), Asia (Du et al., 2008; Matsuishi et al., 2008) and Australia (Hawes & Dadds, 2004; Mellor & Stokes, 2007). While most of

these studies have generally supported Goodman's (1997) five-factor structure, variations to this factor structure have also been reported (Dickey & Blumberg, 2004; Du et al., 2008; R. Goodman, 2001; Hawes & Dadds, 2004; van de Looij-Jansen, Goedhart, de Wilde, & Treffers, 2011; Van Leeuwen et al., 2006; Van Roy et al., 2008). Specifically, researchers who have used exploratory methods in their evaluation of the SDQ's factor structure have found that some of the positively-worded items corresponding to the difficulties subscales have substantial cross-loadings onto the positively-worded prosocial factor (Du et al., 2008; R. Goodman, 2001; Hawes & Dadds, 2004). This has led to suggestions that there may be a method effect present with the positively-worded items, and the cross-loadings are indicative of a positive construal factor, or a factor that indicates informants' willingness to attribute positive qualities rather than strengths or prosocial behaviours (R. Goodman, 2001; van de Looij-Jansen et al., 2011). Subsequent studies using confirmatory factor analysis have supported the possibility of a positive construal method effect, as fit indices have improved when specified models accounted for a positive construal response style (van de Looij-Jansen et al., 2011; Van Roy et al., 2008).

It is also important to note that while the standard parent-rated SDQ has been thoroughly investigated, studies on the preschool parent-rated version are significantly lacking. To our knowledge, only five studies have evaluated the psychometric properties of the preschool parent-rated SDQ (Croft, Stride, Maughan, & Rowe, 2015; Doi, Ishihara, & Uchiyama, 2014; Ezpeleta, Granero, la Osa, Penelo, & Domènech, 2013; Klein, Otto, Fuchs, Zenger, & von Klitzing, 2013; Theunissen, Vogels, de Wolff, & Reijneveld, 2013). These studies have generally found acceptable internal consistency coefficients

and have also supported the Goodman's (1997) five-factor model. However, none of these studies have investigated the possibility of a positive construal method effect. In addition, studies evaluating the parent-rated preschool SDQ have all included children aged 3 years or older, but the questionnaire has been used to assess behavioural problems in children under 3 years (Sim et al., 2013). As such, it is also important to validate the preschool SDQ in children under the age of 3 years.

1.6. Growing Up in New Zealand

Longitudinal research, particularly involving a birth cohort, is important for understanding development across the lifespan. Specifically, it enables researchers to study the factors that influence one's development, and outcomes associated with changes over the life course. Within NZ, there are several notable longitudinal studies, including the Dunedin Multidisciplinary and Christchurch Health and Development Studies. Both studies have made significant contributions to longitudinal research and policy makers, both within NZ and internationally (Fergusson, Boden, & Horwood, 2015; Poulton, Moffitt, & Silva, 2015).

However, the cohorts for both studies were born during the 1970s; therefore, while both studies continue to be major contributors in the field of longitudinal research, the information gleaned is now relevant to contemporary adults rather than children. Furthermore, the NZ environment has also changed substantially in recent years, with the population becoming more ethnically diverse (Smeith & Dunstan, 2004; Statistics New Zealand, 2014). As such, the *Growing Up in New Zealand* study offers the opportunity for investigating child development within a population reflective of contemporary New Zealand.

The prospective *Growing Up in New Zealand* study recruited 6,822 pregnant women with expected delivery dates between 25th April 2009 and 25th March 2010. Women were all recruited from a geographical area containing approximately one third of the NZ birth population, and covered three contiguous District Health Board regions (Morton et al., 2013). Recruited mothers were found to be comparable to NZ parents on key demographic measures, such as maternal age, ethnicity, parity and area-level deprivation (Morton et al., 2013), and cohort members showed generally close alignment to all NZ births between 2007 and 2010 on several birth characteristics and child sex (Morton et al., 2015). In addition, *Growing Up in New Zealand* also recruited 4401 of the mother's partners, defined as someone whom the mother was in a significant social relationship with (Pryor, Morton, Bandara, Robinson, & Grant, 2014).

Data collection for the study focus on six inter-connected domains of child development, specifically: health and wellbeing; cognitive and psychosocial; education; family and whānau (extended family); culture and identity; and neighbourhoods and societal context. To date, major face-to-face data collection waves (DCWs) have occurred during the late prenatal period, and when the child was aged 9 months, 2 years and 4.5 years. The timing of these data collection waves, and the nature of the data collected is another key strength of the study. Specifically, New Zealand longitudinal studies measuring prenatal factors such as stress and teratogen exposure have typically collected this information retrospectively, which may result in the data being vulnerable to recall bias. Furthermore, while some international longitudinal studies have assessed child behavioural problems around 2 years using the CBCL (e.g. Downey et al., 2015; Martinez-Torteya et al., 2009; Oddy et al., 2010; Robinson et al., 2010; Roza et al., 2009,

2010), studies within New Zealand are yet to assess a range of behavioural problems during this early period. With the *Growing Up in New Zealand* study, parent-rated behavioural problems were measured at 2 years using the preschool SDQ, and mother-rated behavioural problems were assessed at 4.5 years using the standard SDQ. In addition, the study shows excellent retention rates, with 90% of the original cohort followed up at the most recent 4.5 year DCW (Morton et al., 2017).

1.7. Thesis rationale

The broad aim of this thesis was to investigate the development of behavioural problems during early childhood, specifically within the *Growing Up in New Zealand* cohort. The following five research questions were specifically of interest: (1) Is the SDQ a reliable and valid measure of behavioural difficulties in 2 years olds? (2) What are the predictors of behavioural difficulties in 2 year olds? (3) What is the stability in behavioural problems over the early childhood period (i.e. from 2 to 4.5 years)? (4) What are the cognitive difficulties associated with persistence and change in early childhood behavioural problems? (5) What are the predictors of persistence and change in early childhood behavioural difficulties?

1.7.1. Is the SDQ a reliable and valid measure of behavioural difficulties in 2 year olds?

As noted in Section 1.5.3, there is limited research on the psychometric properties of the preschool SDQ, with the questionnaire not yet validated in children under the age of 3 years. Therefore, the use of the SDQ with the *Growing Up in New Zealand* cohort at age 2 is unique. To ensure that the use of the questionnaire at 2 years provides valid and reliable measures of child behaviour, Studies 1 and 2 aimed to evaluate the psychometric

properties of the parent-rated preschool SDQ measured at the 2 year DCW. Study 1 evaluated the structural validity and internal consistency reliability of the mother-rated SDQ, and evaluated measurement invariance of the SDQ factor across child's gender, area-level deprivation and mother's ethnicity. Study 2 evaluated the factor structure and internal consistency of the partner-rated SDQ, while also evaluating measurement invariance across both mothers' and partners' ratings, and agreement between the two sets of informants. We expected to find superior model fit for the model accounting for the positive construal method effect relative to the original five factor model, consistent with what has been found in past studies (van de Looij-Jansen et al., 2011; Van Roy et al., 2008). We also expected to find generally acceptable internal consistency reliability for SDQ measures, though there may be low alpha coefficients for peer problems (Stone et al., 2010).

1.7.2. What are the predictors of behavioural difficulties at 2 years?

Once establishing a valid factor structure for the SDQ within the cohort at 2 years, we aimed to identify risk and protective factors associated with serious behavioural difficulties at this age. Using Bronfrenbrenner's (1979) bioecological model as a theoretical framework, and following Nau and Heckert's (2013) suggestion of studying child development within the context of families, we specifically focused on factors during the mother's pregnancy, maternal mental health, and family processes. We also controlled for several factors within the child's macrosystem, including maternal ethnicity and area-level deprivation. By accounting for a range of potential determinants of children's behavioural development, this aspect of the thesis will provide insight on

the strongest predisposing and precipitating risk factors of behavioural problems at 2 years.

With our prenatal variables, we hypothesised that, if significant, teratogen exposure and inadequate folate intake would be associated with an increased risk of behavioural problems in the child; we further expected reduced breastfeeding in the mother and poorer maternal mental health, both prenatally and postnatally, to be associated with behavioural problems in the child. Finally, we expected that greater physical and verbal inter-parental conflict would be associated with an increased risk of behavioural problems, whereas greater formal (i.e. professional) and informal (i.e. friends and family) social support, and a higher maternal parenting self-evaluation would be associated with a reduced risk of behavioural problems. However, given the large number of predictors, we expected that not all of these variables would be significantly associated with behavioural problems in our multivariable models.

1.7.3. What is the stability in behavioural problems over the early childhood period (i.e. from 2 to 4.5 years)?

As noted in Section 1.2, there is evidence that behavioural problems are not necessarily stable during the early childhood period, though research on this topic is generally limited. Given the long term outcomes associated with early behavioural problems, and the focus on the early childhood period for the prevention of later difficulties (Nelson et al., 2003), evaluating the stability in behavioural problems during this period is important. Study 4 was descriptive in nature, and aimed to primarily report on the rates of persistence or change in the categorisation of serious behavioural difficulties from ages 2 to 4.5 years. The study also described the sociodemographic

characteristics of each of the identified behavioural development profiles. Consistent with what has been found by Mathiesen and Sanson (2000), we expected that while some children would persist in their behavioural difficulties from 2 to 4.5 years, a notable proportion would also improve in their behaviour over this period.

1.7.4. What are the cognitive difficulties associated with persistence and change in early childhood behavioural problems?

Given that behavioural problems in childhood have also been associated with language and executive functioning difficulties, the aim of Study 5 was to assess whether behavioural difficulties at either 2 or 4.5 years, as well as persistent behavioural problems across this period were associated with language and cognitive difficulties at 4.5 years. Specific cognitive measures assessed included receptive language, early literacy ability, and executive control. We also evaluated whether a single instance of behavioural problems and persistent behavioural problems were associated with an increased risk of comorbid difficulties across all three cognitive measures. We hypothesised that children with at least a single instance of behavioural problems would show an increased risk of cognitive difficulties relative to children with no behavioural problems during early childhood.

1.7.5. What are the predictors of persistence and change in early childhood behavioural difficulties?

Study 6 aimed to investigate factors associated with the persistence and change in behavioural difficulties from 2 to 4.5 years. As with Study 3, variables of interest included factors specific to the mother’s pregnancy, maternal mental health, and family processes, such as exposure to physical and verbal inter-parental conflict and parenting

behaviours. Furthermore, there is also evidence that inter-parental conflict, specifically physical conflict, is associated with poorer maternal mental health and harsher parenting behaviours (S.-Y. Huang et al., 2009; Levendosky et al., 2006). Therefore, Study 6 also investigated whether maternal mental health and parenting behaviour mediated an association between exposure to physical and verbal inter-parental conflict and the development and persistence in behavioural problems. We expected that poorer maternal mental health (prenatally, postnatally, and when the child is 4.5 years) would be associated with the persistence of behavioural problems during early childhood, whereas poor maternal mental health at 4.5 years would be associated with the development of behavioural problems from 2 to 4.5 years. We further expected that greater authoritative parenting would be associated with an improvement in behavioural difficulties from 2 to 4.5 years. Finally, we hypothesised that poor maternal mental health and harsh parenting behaviour would mediate the association between an exposure to physical and verbal inter-parental conflict and behavioural outcomes in children.

It is important to note that, as this thesis is being submitted as a thesis with publications, each chapter (aside from the General Introduction and General Discussion) is written in the format of a journal article. As such, there may be some level of repetition relating to background information and participant description in particular. In addition, as each chapter has been formatted for specific journals, there may be some minor differences across chapters, such as a summary or conclusion heading within the discussion or subheadings within the abstract.

2. The parent-rated Strengths and Difficulties Questionnaire in two-year-old children

2.1. Chapter Prologue

The following chapter consists of two studies, both of which evaluate the psychometric properties of the parent-rated preschool version of the SDQ. Therefore, both studies aim to address the first research question of this thesis: Is the SDQ a reliable and valid measure of behavioural difficulties in 2 years olds?

Study 1 addressed the psychometric properties of the mother-rated SDQ in 2 year old children from the *Growing Up in New Zealand* cohort. Specifically, Study 1 evaluated the structural validity and internal consistency reliability of the mother-rated SDQ. Both the original five factor model hypothesized by Goodman (1997) and the model accounting for the positive construal method effect were tested (van de Looij-Jansen et al., 2011; Van Roy et al., 2008). The study also addressed measurement invariance of the superior model identified across child's gender, mother's ethnicity and area-level deprivation, to ensure that the factor structure of the SDQ remained consistent across the different demographic groups. As the sample used in the study consisted of a large, population-based cohort, normative information and bandings for behavioural categorisation were also established. The preschool version of the SDQ used at the 2 year DCW can be found in the Appendix A.

Study 2 elaborated on the psychometric properties of the preschool SDQ by evaluating these properties from the father-report. This was conducted with a subsample of the *Growing Up in New Zealand* cohort that had data available from fathers.

Measurement invariance of the model across parents' ratings was assessed, as was the agreement between mothers' and fathers' ratings.

Study 1 is a copy of a manuscript published by Springer Nature in *Journal of Abnormal Child Psychology*. There is only one minor difference between what is in this chapter and what is published; in the published version, area-level deprivation has been referred to as SES, but it is referred to as area-level deprivation in this thesis to remain consistent with subsequent chapters. Please see: D'Souza, S., Waldie, K. E., Peterson, E. R., Underwood, L., & Morton, S. M. (2017). Psychometric properties and normative data for the preschool Strengths and Difficulties Questionnaire in two-year-old children. *Journal of abnormal child psychology*, *45*(2), 345-357. DOI: 10.1007/s10802-016-0176-2.

Study 2 is a copy of a manuscript published by SAGE in *Assessment*. Please see: D'Souza, S., Waldie, K. E., Peterson, E. R., Underwood, L., & Morton, S. M. (2017). The Strengths and Difficulties Questionnaire: Factor Structure of the Father-Report and Parent Agreement in 2-Year-Old Children. *Assessment*. Advanced online publication. DOI: 10.1177/1073191117698757.

Any supplementary material referred to in this chapter is displayed in Appendix A.

2A. Psychometric properties and normative data for the preschool Strengths and Difficulties Questionnaire in two-year-old children (Study 1)

2A.1 Abstract

The Strengths and Difficulties Questionnaire (SDQ) is a popular standardised instrument typically used for screening psychopathology in children and adolescents. However, peer reviewed studies evaluating the psychometric properties of the parent-rated preschool SDQ are lacking. The current study involved mothers of 5,481 2 year olds (52% male) from the *Growing Up in New Zealand* cohort, and investigated the psychometric properties of the preschool SDQ within this cohort. Confirmatory factor analysis was used to evaluate the SDQ's factor structure and test for measurement invariance of the factor model. Cronbach's alpha was used to measure the internal consistency of the subscales and total difficulties scale. We found support for a modified five-factor model, in which the prosocial factor was extended into a positive construal factor by allowing cross-loadings of reverse-scored items. Full measurement invariance was found across gender and socioeconomic status, and partial invariance was found across mother's ethnicity. Cronbach's alpha was satisfactory for all subscales (α range = .71 - .84), except peer problems (α = .54). Normative scores and bandings for normal, borderline and abnormal ranges are described for each subscale. Analyses revealed group differences in scores for child's gender, mother's ethnicity and area-level deprivation. Overall, satisfactory psychometric properties were found for the preschool SDQ in 2 year olds, indicating that that the questionnaire can be used in very young children.

2A.2 Introduction

Identification of behavioural and emotional problems during early childhood is vital, as studies have revealed that psychiatric disorders can present during preschool years (Egger & Angold, 2006; Ezpeleta, Osa, et al., 2013; Poulou, 2013). Furthermore, children with psychosocial problems are more at risk of adverse mental and physical health outcomes later in life (Bardone et al., 1998; Bittner et al., 2007; Caspi, Moffitt, Newman, & Silva, 1996; Fergusson et al., 2005; Fergusson & Lynskey, 1998; Hofstra, van der Ende, & Verhulst, 2002; Odgers et al., 2007). For this reason, it is essential that appropriate screening instruments are available to detect individuals in need of further psychological assessment so that interventions can begin from early in childhood.

The Strengths and Difficulties Questionnaire (SDQ) ((R. Goodman, 1997) is a tool available for screening childhood psychopathology. The 25-item questionnaire has four difficulties subscales (emotional symptoms; peer problems; hyperactivity-inattention; conduct problems), as well as a prosocial behaviour subscale. Items are worded positively (all prosocial behavior items and five reverse-scored items from the difficulties subscales) and negatively, with the difficulties subscales summed to give a measure of total difficulties. Scores for each subscale as well as the total difficulties measure can be categorised into normal, borderline and abnormal ranges.

The SDQ has several advantages over other screening instruments, namely its brevity and its focus on competencies as well as difficulties (R. Goodman, 1997).The standard SDQ is available in parent- and teacher-report versions for children aged 4 to 17 years, with a self-report also available for children aged 11 to 17 years. A slightly modified version of the questionnaire has since been created for informants of preschool-

aged children (i.e., 2 to 4 years) (Youth in Mind, 2014). Normative data for school-aged children is available on the SDQ website (www.sdqinfo.com; Youth in Mind, 2014) for several European countries, Australia, Japan and the United States of America (USA). For preschoolers, the website only has normative data available for Japanese, Spanish and United Kingdom (UK) populations.

2A.2.1 Factor structure of the SDQ

The factor structure of the standard parent-rated SDQ has been variously evaluated in children aged 3 to 19 years from Europe (Becker et al., 2004; R. Goodman, 2001; Van Leeuwen et al., 2006; Van Roy et al., 2008; Woerner et al., 2004), the USA (Dickey & Blumberg, 2004; He et al., 2013; Hill & Hughes, 2007), Asia (Du et al., 2008; Matsuishi et al., 2008) and Australia (Hawes & Dadds, 2004; Mellor & Stokes, 2007). The results have generally supported the five-factor structure proposed by (R. Goodman, 1997). However, there have also been reports of a three-factor solution, consisting of externalising (hyperactivity-inattention and conduct items), internalising (emotional and peer items) and prosocial (prosocial and several reverse-scored items) factors (Dickey & Blumberg, 2004; Van Leeuwen et al., 2006). Studies that have used exploratory factor analysis have found that certain positively-worded, reverse-scored items also have substantial cross-loadings on the prosocial subscale (Du et al., 2008; R. Goodman, 2001; Hawes & Dadds, 2004). These findings have led to the suggestion that this extended prosocial factor may also serve as a ‘positive construal’ factor, and thus reflect informants’ willingness to attribute positive qualities (R. Goodman, 2001).

The possibility of a positive construal method effect has since been supported in studies using confirmatory factor analysis; model fit has improved when models have

accounted for a positive construal response style. Van de Looij-Jansen, Goedhart, de Wilde and Treffers (2011) evaluated a four-factor model, with combined peer and emotional subscales, as well as the original five-factor model of the self-report SDQ, and found that both models showed significantly better model fit when reverse-scored items were allowed to cross-load onto the prosocial factor. According to the authors, the results indicate that the reverse-scored items reflect both the associated problem factor as well as a positive construal response style. With the parent-report version of the SDQ, Van Roy et al. (2008) found superior fit when including an additional positive construal factor in their model, consisting of the five reverse-scored items. However, this factor did not account for the prosocial items, which are also positively construed.

2A.2.2 Internal consistency reliability of the SDQ

Scale reliability, indexed by internal consistency coefficients such as Cronbach's alpha, are generally moderate to good for SDQ measures (Stone et al., 2010). While a coefficient greater than .70 is usually recommended for a measure (Nunnally, Bernstein, & Berge, 1967), most studies evaluating the SDQ have considered that coefficients of .60 and above are acceptable (Hawes & Dadds, 2004; Matsuishi et al., 2008; van de Looij-Jansen et al., 2011; Van Leeuwen et al., 2006; Woerner et al., 2004). A review of 48 studies by Stone et al. (Stone et al., 2010) found that weighted mean alpha coefficients for parent-rated SDQ measures was above .60 for all SDQ measures, except conduct (α = .58) and peer subscales (α = .53). Lower alpha coefficients have frequently been reported for the peer subscale in particular (α range = .30 - .59; Du et al., 2008; R. Goodman, 2001; Hawes & Dadds, 2004; Matsuishi et al., 2008; Van Leeuwen et al., 2006; Woerner et al., 2004), implying that items for this subscale are not always interpreted as reflecting

the same construct. However, Cronbach's alpha can also be affected by scale length (Nunnally & Bernstein, 1994; Streiner, 2003), therefore it is possible that low alpha values with the SDQ are due to the small number of items for each subscale. Nevertheless, excellent internal consistency is often found for the total difficulties score, with past studies generally reporting alpha coefficients well above .70 (Becker et al., 2004; R. Goodman, 2001; Hawes & Dadds, 2004; Van Roy et al., 2008; Woerner et al., 2004).

2A.2.3 Preschool studies

The factor structure, internal consistency and normative scores of the parent-report form of the SDQ in school-aged children have been thoroughly investigated. However, research focusing on the preschool version of the SDQ is limited. In the preschool questionnaire, three items have been adjusted to be more suitable for preschool children. Specifically, the items 'often lies or cheats' and 'steals from home, school or elsewhere' have been replaced by 'often argumentative with adults' and 'can be spiteful to others', respectively, on the conduct problems subscale; and the item 'can stop and think things out before acting' replaces 'thinks things out before acting' on the hyperactivity subscale. Given this qualitative difference between the preschool SDQ and the standard SDQ, it is important to thoroughly evaluate the validity and reliability of the preschool questionnaire.

Nevertheless, only five studies have evaluated the psychometric properties of the preschool version to date (Croft et al., 2015; Doi et al., 2014; Ezpeleta, Granero, et al., 2013; Klein et al., 2013; Theunissen et al., 2013). Similar to findings with older children, these studies have generally shown satisfactory model fit for the original five-factor

model and acceptable internal reliability coefficients for the SDQ measures (α range = .45 - .82), with lower coefficients sometimes reported for peer problems (Doi et al., 2014; Theunissen et al., 2013). None of these studies have directly explored the possibility of a positive construal factor, and they lacked normative information for this age group. Furthermore, while the preschool version of the SDQ has been used to identify behavioural and emotional problems in children as young as 30 months (Sim et al., 2013), this version of the SDQ has only been validated in children 3 years or older. Consequently, it is necessary to validate the preschool SDQ in children under the age of 3 years.

It is important to note that studies evaluating the validity, reliability and normative data of the English version of the SDQ have primarily been conducted in the UK (Croft et al., 2015; R. Goodman, 2001), the USA (Dickey & Blumberg, 2004; He et al., 2013; Hill & Hughes, 2007) and Australia (Hawes & Dadds, 2004; Kremer et al., 2015; Mellor, 2005; Mellor & Stokes, 2007). The current study aimed to evaluate the factor structure and internal consistency of the English preschool version of the parent-rated SDQ, answered by mothers of 2 year olds from a broadly representative community sample in New Zealand (NZ), while also establishing norms (means and bandings for normal, borderline and abnormal ranges) for preschool-aged children in NZ. Given that past research has indicated that there may be a positive construal method effect (van de Looij-Jansen et al., 2011; Van Roy et al., 2008), we tested both the original five-factor model, as well as a modified five-factor model to account for a positive construal response style. These models are both a priori models, with the former model based on the work by Goodman (1997) and the latter model based on the model used by van de

Looij-Jansen et al. If the SDQ follows Goodman's (1997) five-factor model, we expect to find satisfactory model fit for the original model. However, if there is a positive construal method effect, we hypothesise that the modified five-factor model will show better model fit than the original model. To ensure the validity of the SDQ factor structure across different socio-demographic groups, measurement invariance was tested across gender, area-level deprivation and mother's ethnicity. If invariance was established, group differences were also explored.

2A.3 Methods

2A.3.1 Participants

Growing Up in New Zealand is a prospective cohort study of NZ children with expected delivery dates between 25th April 2009 and 25th March 2010. Participants were recruited via 6,822 pregnant mothers to provide a socioeconomically and ethnically diverse cohort (Morton, Grant, et al., 2014). Detailed description of the study's design and recruitment can be found elsewhere (Morton et al., 2013; Morton, Grant, et al., 2014). In brief, mothers of the sample were recruited during pregnancy and selected from the geographical area containing about one third of the NZ birth population, covered by three contiguous District Health Board regions (Morton et al., 2013). There were no other inclusion or exclusion criteria (Morton et al., 2013). Based on data available from Statistics New Zealand from the period of 2006 to 2008, the demographic characteristics of the mothers in the cohort are comparable with those of all NZ parents on key parameters, specifically maternal age, ethnicity, parity and SES (Morton et al., 2013). Furthermore, the *Growing Up in New Zealand* cohort showed generally close alignment to all NZ births between 2007 and 2010 on several birth characteristics and child sex

(Morton et al., 2015). Ethical approval for the study was obtained from the Ministry of Health Northern Y Regional Ethics Committee (NTY/08/06/055). Written informed consent was obtained from all participating women.

Longitudinal data collection in the study focuses on six inter-connected domains of child development: health and wellbeing; psychological and cognitive development; education; family and whānau (extended family); culture and identity; and neighbourhoods and the societal context. Major face-to-face data collection waves have occurred during the late antenatal period, at 9 months and at 2 years via computer assisted personal interviews (CAPI).

Children were included in the current study if their mothers had provided complete gender, deprivation and SDQ data[2]. This resulted in a final sample of 5,481 children, of which 2,823 (52%) were male and 3,145 (57%) had mothers whose self-reported main ethnicity was European.

The final sample had a greater percentage of children with European mothers and from low deprivation areas when compared to children excluded from the sample, *ps* < .01; however, these effects were small, Cramer's $V < .30$. Furthermore, the study's sample remains large and diverse enough to explore subgroup differences. There were no

[2] We included children with complete gender, deprivation and SDQ data (as opposed to complete gender, deprivation, SDQ and mother's ethnicity data), as our analyses with mother's ethnicity only include a subsample of the total sample due to the exclusion of the 'Other' ethnic group (see discussion of mother's ethnicity measure in methods). As such, some participants from our final sample of 5,481 children have missing data for mother's self-prioritised ethnicity (n = 16).

gender differences present between children included and excluded in the study's sample. As the final sample shows only small differences from the full cohort, we believe that the sample is largely representative of 2 year old New Zealanders.

2A.3.2 Measures

Strength and Difficulties Questionnaire. The English (UK) preschool version of the parent-report SDQ (R. Goodman, 1997) was used. The questionnaire consists of five subscales, each measured by five items, which cover emotional symptoms, peer problems, hyperactivity-inattention, conduct problems and prosocial behaviour. Items are rated on a 3-point Likert scale as either *not true*, *somewhat true*, or *certainly true*. Responses are scored 0-2 for negatively-worded items and prosocial items. Positively-worded items from the difficulties subscales are reverse-coded. Subscales can range from zero to 10, and the total difficulties score (which is a sum of the difficulties subscales), ranges from zero to 40. Higher scores reflect greater difficulties for the difficulties measures, or greater prosocial behaviour for the prosocial subscale.

Socio-demographic variables. Socio-demographic information of interest in this study included the child's gender, mother's ethnicity and area-level deprivation. Information on mother's ethnicity was generally collected during the antenatal period, and child's gender was obtained approximately 6 weeks following birth. Deprivation at 2 years was used in this study.

Mother's ethnicity was determined by self-report in the antenatal questionnaire, where mothers were asked what ethnic groups(s) they belong to and what their self-reported main (self-prioritised) ethnicity is. Participants were able to provide a description of their ethnic group at a detailed level (corresponding to Statistics New

Zealand Level 3/4 hierarchy), with interviewers able to refer to a list of 32 possible answers as well as an open ended ‘Other, please specify’ category. Multiple responses were collected. For the purposes of this study, the self-prioritised (‘main’) ethnicity has been utilised, categorised into five Level 1 Statistics New Zealand categories (Statistics New Zealand, 2005): European, Māori, Pacific, Asian and Other (including Middle Eastern, Latin American and African). External prioritisation was used for mothers with multiple ethnicities who did not provide a main ethnicity (Statistics New Zealand, 2004) The ‘Other’ ethnic group was excluded from analyses in the current study because of its particular heterogeneous composition and small group size (n = 173).

The NZDep2006 Index is an area-level measure of SES, determined using socioeconomic indicators from the 2006 NZ census (Salmond, Crampton, & Atkinson, 2007). Deprivation scores range from least deprived (decile 1) to most deprived (decile 10). In the current study, area-level deprivation was categorised into high (deciles 8-10), medium (deciles 4-7) and low (deciles 1-3) deprivation.

2A.3.3 Data analysis

Confirmatory factor analysis (CFA) with robust diagonal weighted least squares estimation was used to test the original five-factor structure proposed by Goodman (1997). We also added a model that accounted for a positive construal response style. This latter model allowed positively-worded, reverse-scored items to cross-load onto the prosocial subscale, and is similar to the best-fitting model found by van de Looij-Jansen et al. (2011), though our model does not include correlated errors. The 3-point Likert scale SDQ items were treated as ordinal variables in the analyses. The marker variable strategy was used to set the scale for latent variables. Indices used to evaluate the fit of

the CFA models included the comparative fit index (CFI), the Tucker-Lewis Index (TLI) and the root mean square error of approximation (RMSEA). CFI and TLI values of around .90 or greater and RMSEA values less than .60 indicate acceptable model fit (Hu & Bentler, 1999). Due to its sensitivity to sample size, chi-square statistics were reported but not used to test model fit (Cheung & Rensvold, 2002).

Multiple group CFA was conducted to test for measurement invariance across child's gender, mother's ethnicity and deprivation. Configural, metric and scalar invariance were tested. Configural invariance is supported if each factor is associated with the same set of items across groups. To test for configural invariance, the best fitting model identified in the initial CFA was tested, with factor loadings and thresholds free to vary across groups (Model 1). Metric invariance is defined as the invariance of factor loadings across groups, which implies that groups are interpreting and responding to items in the same way (Stone et al., 2013). To test for metric invariance, a second model (Model 2) was estimated, in which factor loadings were constrained to be equal across groups but thresholds were free to vary. If Model 2 was not significantly different from Model 1, then metric invariance was supported. Scalar invariance is necessary to ensure that group differences in the means of items are due to differences in the means of underlying constructs (Stone et al., 2013). To test for scalar invariance, factor loadings and thresholds were constrained to be equal across groups (Model 3). If Model 3 was not significantly worse than Model 2, scalar invariance was supported. Statistical significance when comparing models was determined using the change in CFI (ΔCFI) rather than chi-square statistics, as the latter is highly sensitive to sample size (Cheung & Rensvold, 2002). If ΔCFI between a constrained model and a less constrained model is equal to or

less than .01, then we can conclude that models do not significantly differ and invariance is supported.

Internal consistency of SDQ subscales and the total difficulties score was determined using Cronbach's alpha and mean inter-item correlation (MIC) coefficients. We evaluated MIC as Cronbach's alpha values may be influenced by the short subscale length (Nunnally & Bernstein, 1994; Streiner, 2003). MIC coefficients of .20 and above indicate acceptable internal consistency (Nunnally & Bernstein, 1994; Piedmont, 2014). Calculations of alpha and inter-item correlation coefficients were based on polychoric correlations, rather than product-moment correlations, to account for the ordinal response distribution of SDQ items. Correlations between SDQ subscales and total difficulties scores were determined using Pearson product-moment correlations.

One-way MANOVAs and follow-up ANOVAs were conducted separately for child's gender, mother's ethnicity and deprivation to assess group differences in SDQ subscales. One-way ANOVAs were used to test group differences in total difficulties scores for mother's ethnicity and deprivation. For child's gender, the difference in total difficulties was tested using an independent samples *t*-test. For MANOVA and ANOVA analyses, *Bonferroni* corrections were applied to post-hoc tests if the homogeneity of variance assumption was met, otherwise Games-Howell tests were used. Cohen's *d* (J. Cohen, 1988) was used to evaluate effect sizes for mean differences. Group comparisons were only conducted for a SDQ measure if at least partial invariance was found. This was to ensure that comparisons between the means of groups on a measure was due to genuine differences in the values of the latent construct and not due to group differences in scale metrics or additive bias (Steenkamp & Baumgartner, 1998). Steenkamp and

Baumgartner state that for comparisons of group means to be made, at least two items per factor need to achieve metric and scalar invariance.

Bandings for defining the normal, borderline and abnormal ranges for the SDQ subscales and total difficulties score were guided by the distribution of raw scores. Similar to the procedure used by Goodman (1997), bandings for each SDQ measure were selected so that approximately 10% of children with the most extreme scores were placed in the 'abnormal' range, the next 10% were placed in the 'borderline' range, and the remaining 80% were placed in the 'normal' range.

Statistical packages lavaan (Rosseel, 2012) and semTools (Pornprasertmanit, Miller, Schoemann, & Rosseel, 2013) in R were used for all CFA and Cronbach's alpha calculations. IBM SPSS Statistics version 22 was used for all other analyses. Statistical significance for factor loadings, Pearson correlations, MANOVA and ANOVA analyses was given at an alpha level of .05.

2A.4 Results

2A.4.1 Confirmatory factor analysis

When evaluating the original five factor model within the whole sample, results revealed that model fit indices did not meet the recommended model fit thresholds, $\chi^2_{(265)} = 7240.09$; CFI = .787; TLI = .759; RMSEA = .069. Standardised factor loadings are presented in Table 2A.1. All items loaded significantly onto their respective factor, *ps* < .05.

Table 2A.1.
Standardised factor loadings for the original and modified five-factor models, evaluated within the whole sample.

	Original Model					Modified Model				
Item	Emotional Symptoms	Peer Problems	Hyperactivity-Inattention	Conduct Problems	Prosocial Behaviour	Emotional Symptoms	Peer Problems	Hyperactivity-Inattention	Conduct Problems	Positive Construal
3. Somatic	0.58					0.58				
8. Worries	0.68					0.68				
13. Unhappy	0.78					0.77				
16. Clingy	0.48					0.48				
24. Fears	0.58					0.59				
6. Solitary		0.4					0.46			
11. Good friend*		0.24					.01[a]			-0.34
14. Popular*		0.60					0.28			-0.54
19. Bullied		0.57					0.68			
23. Best with adults		0.44					0.54			
2. Restless			0.69					0.71		
10. Fidgety			0.73					0.77		
15. Distractible			0.69					0.71		
21. Reflective*			0.34					0.04		-0.45
25. Persistent*			0.49					0.24		-0.39
5. Tempers				0.6					0.61	
7. Obedient*				0.49					0.23	-0.44
12. Fights				0.69					0.71	
18. Argues				0.67					0.69	
22. Spiteful				0.61					0.63	
1. Considerate					0.72					0.68
4. Shares					0.53					0.52
9. Caring					0.56					0.56
17. Kind to kids					0.62					0.59
20. Helps out					0.46					0.51

Note: * reverse-scored items; [a] factor loading $p > .05$.

Allowing reverse-scored items to cross-load onto the prosocial factor improved model fit, such that model fit statistics were acceptable, $\chi^2_{(260)}$ = 3361.02; CFI = .905; TLI = .891; RMSEA = .047. Standardised factor loadings for the modified five-factor model are also provided in Table 2A.1. Near zero loadings were found for items 11 (good friend) and 21 (reflective) on the peer problems and hyperactivity-inattention subscales, respectively, though the factor loading was only non-significant for item 11. Factor loadings for all other items were significant, *ps* < .05. In general, the reverse-scored items now appear to be loading primarily onto the positive construal factor, with secondary loadings onto their original factor.

2A.4.2 Measurement invariance tests

The model with the positive construal factor was then tested for measurement invariance. Adequate fit of the modified five-factor model was also generally found within each of the subgroups (Table 2A.2). CFI, ΔCFI and other model fit indices for Models 1, 2 and 3 for child's gender, mother's ethnicity and deprivation are also presented in Table 2A.2. Configural invariance was supported for child's gender, mother's ethnicity and deprivation, as model fit indices met satisfactory thresholds. Metric invariance was supported, as constraining factor loadings to be equal across groups resulted in a ΔCFI of less than .01 for child's gender, mother's ethnicity and deprivation. ΔCFI between Model 2 and Model 3 was less than .01 for child's gender and deprivation, but was greater than .01 (ΔCFI = .013) for mother's ethnicity. Therefore, full scalar invariance was supported for gender and deprivation. Examination of the Model 3 modification indices for ethnicity indicated that the second threshold for item 5 (tempers) and the first threshold for item 6 (solitary) may be non-invariant across ethnic groups.

Allowing the second threshold for item 5 to vary freely resulted in a ΔCFI of .01, relative to Model 2, thus partial scalar invariance was found for mother's ethnicity.

Table 2A.2.
Fit indices for invariance analyses for the modified five-factor model across child's gender, mother's ethnicity and socioeconomic status.

	X^2	df	RMSEA	TLI	CFI	ΔCFI[a]
Gender						
Male	1801.48	260	0.046	0.894	0.908	
Female	1763.17	260	0.047	0.886	0.901	
1. Configural invariance	3564.38	520	0.046	0.89	0.905	
2. Metric invariance	3360.239	545	0.043	0.903	0.912	0.007
3. Scalar invariance	3523.59	565	0.044	0.902	0.907	0.005
Ethnicity						
European	1733.19	260	0.042	0.899	0.913	
Māori	671.59	260	0.046	0.893	0.907	
Pacific	653.68	260	0.046	0.868	0.886	
Asian	552.09	260	0.041	0.855	0.875	
1. Configural invariance	3494.83	1040	0.042	0.893	0.907	
2. Metric invariance	3720.791	1115	0.042	0.894	0.901	0.006
3. Scalar invariance	4141.155	1175	0.044	0.885	0.888	0.013
4. Partial scalar invariance[b]	4054.733	1172	0.043	0.888	0.891	0.01
Deprivation						
High	1436.12	260	0.048	0.88	0.896	
Medium	1213.16	260	0.043	0.896	0.91	
Low	892.46	260	0.04	0.901	0.914	
1. Configural invariance	3526.454	780	0.044	0.892	0.906	
2. Metric invariance	3446.9	830	0.042	0.903	0.911	0.005
3. Scalar invariance	3632.752	870	0.042	0.903	0.906	0

Note: [a] ΔCFI = CFI of constrained model – CFI of less constrained model. Only the absolute value is given;
[b] threshold for item 5 (tempers) varied freely.

Table 2A.3.
Cronbach's alpha and mean inter-item correlations (MIC) for each SDQ measure and correlations between measures.

	Cronbach's alpha	MIC	1	2	3	4	5
1. Emotional Symptoms	0.75	0.37					
2. Peer Problems	0.54	0.2	.36**				
3. Hyperactivity-Inattention	0.71	0.33	.23**	.23**			
4. Conduct Problems	0.74	0.36	.37**	.30**	.43**		
5. Prosocial Behaviour [a]	0.71	0.33	-.07**	-.22**	-.28**	-.27**	
6. Total Difficulties	0.84	0.31	.66**	.64**	.72**	.77**	-.31**

Note: ** $p < .001$.
[a] Cronbach's alpha, mean inter-item correlation and correlation coefficients have been presented for the prosocial behaviour subscale to remain consistent with the literature.

Table 2A.4.
Means and bandings for the normal, borderline and abnormal ranges of each SDQ measure and percentage of sample within each band.

		Normal range		Borderline range		Abnormal range	
Scale	M (SD)	Raw score	%	Raw score	%	Raw score	%
Emotional Symptoms	1.82 (1.61)	0 – 3	85.7	4	7.2	5 – 10	7.1
Peer Problems	2.15 (1.64)	0 – 3	78.9	4	11.9	5 – 10	9.2
Hyperactivity-Inattention	4.34 (2.12)	0 – 6	84.4	7	7.7	8 – 10	7.9
Conduct Problems	3.14 (1.96)	0 – 4	76.3	5	11.4	6 – 10	12.3
Prosocial Behaviour [a]	7.14 (1.82)	6 – 10	80.6	5	12.4	0 – 4	7.0
Total Difficulties	11.44 (5.14)	0 – 15	78.9	16 – 18	11.3	19 – 40	9.8

Note: [a] bandings have been presented for the prosocial behaviour subscale to remain consistent with the literature.

2A.4.3 Internal consistency

Cronbach's alpha and MIC coefficients for SDQ subscales and the total difficulties score are presented in Table 2A.3. The alpha coefficient was low for peer problems, $\alpha = .54$, but satisfactory for all other measures, $\alpha > .70$. Peer problems also had a low but acceptable MIC coefficient, MIC = .20. MIC values were satisfactory for all other measures, MIC > .30. The emotional symptoms subscale obtained the highest alpha and MIC, $\alpha = .75$; MIC = .37. The alpha and MIC coefficients for the total difficulties score were .84 and .31, respectively.

2A.4.4 Correlations between SDQ measures

Correlation coefficients between subscales are presented in Table 2A.3. All subscales were significantly correlated, *ps* < .001. The highest correlation was between the conduct problems subscale and hyperactivity-inattention, $r = .43$. Moderate correlations were also found between emotional symptoms and peer problems, $r = .36$; conduct problems and emotional symptoms, $r = .37$; and between conduct problems and peer problem, $r = .30$. As expected, strong correlations were found between the total difficulties score and difficulties subscales, *rs* > .60. There was a moderate correlation between the total difficulties score and prosocial behaviour, $r = -.31$. All other correlations were relatively small, $r < .30$.

2A.4.5 Means, bandings and group differences

Mean scores and bandings for SDQ subscales are presented in Table 2A.4. Given the nature of the scores, splits of 80%, 10% and 10% of the sample into normal, borderline and abnormal groups, respectively, was only approximate. The exact percentage of the sample in each category for each of the SDQ measures is also provided

in Table 2A.4. At least partial measurement invariance of the model was found for child's gender, mother's ethnicity and deprivation status. Therefore, one-way MANOVAs and ANOVAs were conducted to evaluate group differences in SDQ scores. As described earlier, support was found for the modified five-factor model and not the original five-factor model. As such, only group comparisons for the difficulties subscales and total difficulties score have been described below. Group differences for the original prosocial subscale are provided in the supplementary Table S1. Means for the difficulties measures split by child's gender, mother's ethnicity and socioeconomic status are presented in Table 2A.5.

Child's gender. There was a significant main effect of child's gender on SDQ subscales, $F_{(4, 5476)} = 20.39$, $p < .001$. Follow-up ANOVAs revealed that 2 year old boys had significantly greater scores on the peer problems and hyperactivity-inattention subscales than girls, peer problems $F_{(1, 5479)} = 21.55$, $p < .001$; hyperactivity-inattention $F_{(1, 5479)} = 50.29$, $p < .001$. However, this difference was very small, peer problems $d = 0.12$; hyperactivity-inattention $d = 0.19$. An independent samples *t*-test revealed that boys had significantly greater total difficulties relative to girls, but this effect was also small in magnitude, $t_{(5479)} = 4.34$, $p < .001$; $d = 0.12$.

Mother's ethnicity. There was a significant main effect of mother's ethnicity on child's SDQ subscale scores at 2 years, $F_{(12, 15861)} = 98.57$, $p < .001$. Follow-up ANOVAs showed that there was a significant difference between maternal ethnic groups for all difficulties subscales, emotional symptoms $F_{(3, 5288)} = 255.31$; peer problems $F_{(3, 5288)} = 205.05$; hyperactivity-inattention $F_{(3, 5288)} = 36.94$; conduct problems $F_{(3, 5288)} = 167.39$, *ps* $< .001$ for all. European mothers gave their children significantly lower ratings on the

emotional symptoms and peer problems subscales relative to mothers from all other ethnic groups, with moderate to large effect sizes present, *ps* < .001 for all; emotional symptoms 0.50 < *d* < 1.11; peer problems 0.59 < *d* < 0.73. Māori and Asian mothers had children with significantly lower emotional symptoms scores than children born to Pacific mothers, *ps* < .001 for all; this difference was small between children of Maori and Pacific mothers, *d* = 0.39, but moderate between children of Asian and Pacific mothers, *d* = 0.50. On the hyperactivity-inattention subscale, children born to Asian or European mothers had significantly lower scores than children born to mothers of Māori or Pacific ethnicity, but this effect was small, *ps* ≤ .001 for all; 0.22 < *d* < 0.36. Children of Asian and European mothers also had significantly lower scores on the conduct problems subscale relative to children of Māori and Pacific mothers, with moderate to large effects present, *ps* ≤ .001 for all; 0.64 < *d* < 0.80. No other differences were significant.

One-way ANOVA results showed that there was a significant main effect of mother's ethnicity on children's total difficulties score, $F_{(3, 5288)} = 288.31$, $p < .001$. Children born to European mothers obtained significantly lower scores than children born to mothers from the other ethnic groups, *ps* < .001 for all; these differences were large when compared to children of Maori mother, *d* = 0.81, and Pacific mothers, *d* = 1.06, but small when compared to children of Asian mothers, *d* = 0.43. Asian mothers gave their children significantly lower total difficulties scores than Māori and Pacific mothers, *ps* < .001; the effect was small between children of Asian and Maori mothers, *d* = 0.37, but moderate between children of Asian and Pacific mothers, *d* = 0.60. Children with Māori

mothers also had lower scores than children born to Pacific mothers, but these differences were small in magnitude, $p < .001$; $d = 0.21$.

Area-level deprivation. There was a significant main effect of deprivation on SDQ subscale scores at 2 years, $F_{(8, 10952)} = 61.51$, $p < .001$. There was a significant difference between deprivation groups on all difficulties measures, emotional symptoms $F_{(2, 5478)} = 152.52$; peer problems $F_{(2, 5478)} = 122.73$; hyperactivity-inattention $F_{(2, 5478)} = 32.86$; conduct problems $F_{(2, 5478)} = 138.45$, *ps* < .001 for all. The one-way ANOVA on total difficulties score also found a significant main effect of deprivation, $F_{(2, 5478)} = 208.31$, $p < .001$.

Table 2A.5.
Mean scores for SDQ difficulties measures, split by child's gender, mother's ethnicity and socioeconomic status.

	N	Emotional Symptoms M (SD)	Peer Problems M (SD)	Hyperactivity-Inattention M (SD)	Conduct Problems M (SD)	Total Difficulties M (SD)
Gender						
Male	2823	1.80 (1.62)	2.25 (1.66)	4.53 (2.12)	3.14 (1.98)	11.74 (5.21)
Female	2658	1.83 (1.59)	2.05 (1.61)	4.13 (2.10)	3.13 (1.95)	11.13 (5.06)
Ethnicity[a]						
European	3145	1.39 (1.28)	1.77 (1.49)	4.12 (2.16)	2.71 (1.80)	9.99 (4.51)
Māori	759	2.26 (1.70)	2.67 (1.69)	4.75 (2.13)	4.11 (2.03)	13.79 (5.40)
Pacific	720	2.97 (1.92)	2.88 (1.69)	4.88 (1.85)	4.19 (2.01)	14.92 (5.24)
Asian	668	2.07 (1.67)	2.68 (1.65)	4.30 (1.99)	2.89 (1.78)	11.94 (4.67)
Deprivation						
High	1952	2.30 (1.78)	2.59 (1.68)	4.62 (2.08)	3.69 (2.09)	13.22 (5.42)
Medium	1996	1.62 (1.50)	2.02 (1.60)	4.27 (2.12)	2.95 (1.89)	10.86 (4.82)
Low	1533	1.45 (1.34)	1.78 (1.51)	4.05 (2.13)	2.66 (1.71)	9.95 (4.50)

Note: [a] the total N for mother's ethnicity is 5,292 due to the exclusion of children with missing data (n = 16) and children whose mothers belonged to the 'Other' ethnic group (n = 173).

As area-level deprivation is an ordinal variable, linear contrasts were conducted to evaluate the presence of a linear trend. Results revealed that there was a significant linear trend for all difficulties measures, indicating that children's scores increased as deprivation level increased, emotional symptoms $F_{(1, 5478)} = 253.71$; peer problems $F_{(1, 5478)} = 222.15$; hyperactivity-inattention $F_{(1, 5478)} = 62.79$; conduct problems $F_{(1, 5478)} = 248.09$; total difficulties $F_{(1, 5478)} = 372.73$, *ps* < .001 for all. Effect sizes were small for the hyperactivity-inattention subscale, $0.10 < d < 0.27$. For all other subscales and the total difficulties measure, effect sizes were moderate between high and low deprivation groups, $0.50 < d < 0.53$; all other differences were small in magnitude, $0.12 < d < 0.46$.

2A.5. Discussion

The current study investigated the psychometric properties, means and bandings of the parent-rated preschool SDQ in 2 year old children. Participants were members of the *Growing Up in New Zealand* cohort, which is broadly representative of all current NZ births on several key sociodemographic and birth measures (Morton et al., 2013, 2015). The current study's sample includes only those with complete SDQ, gender and deprivation data, but differs only minimally from the full cohort on sociodemographic measures such as mother's ethnicity and deprivation. Therefore, our results are largely generalizable to other 2 year old NZ children. When compared to other preschool studies (Doi et al., 2014; Ezpeleta, Granero, et al., 2013; Iida, Moriwaki, Komatsu, & Kamio, 2014; Klein et al., 2013; Theunissen et al., 2013), our sample generally had a higher response rate for the SDQ, and included a younger and more ethnically diverse cohort.

We tested the original five-factor model proposed by Goodman (1997), as well as a modified five-factor model where the prosocial factor was extended into a positive

construal factor. This latter model was tested as previous studies have indicated that there appears to be a method effect with the positively worded items of the SDQ (van de Looij-Jansen et al., 2011; Van Roy et al., 2008). Specifically, these items seemed to be reflecting a positive construal response style. In saying that, we cannot exclude the possibility that this positive construal factor is still reflecting prosocial behaviour. Indeed, many of these reverse-scored items are still asking about prosocial behaviours (e.g. good friend) or traits that are important for prosociality (e.g. obedient). van de Looij-Jansen et al. have suggested that this extended measure may also reflect agreeableness and dutifulness in the self-report version of the SDQ. Our research suggests that this construct is possibly also being measured with the parent-report version. Future research should investigate whether this positive construal factor is still a valid measure of prosocial behaviour, perhaps by examining its association with other prosocial measures or known correlates of prosocial behaviour.

We found poor model fit for the original five-factor model proposed by Goodman (1997). Extending the prosocial factor into a positive construal factor by allowing positively-worded reverse-scored items to cross-load onto the factor, however, improved the model fit so that it met satisfactory criteria. While our study does not support previous research that have found satisfactory model fit for the original model (Becker et al., 2004; Croft et al., 2015; Ezpeleta, Granero, et al., 2013; He et al., 2013; Klein et al., 2013; Van Leeuwen et al., 2006), our findings are consistent with studies on older children that have found better model fit when accounting for a positive construal response style (van de Looij-Jansen et al., 2011; Van Roy et al., 2008). Similarly, van de Looij-Jansen et al. found a poor model fit of the original five-factor model when

evaluating the self-report version of the SDQ, but satisfactory model fit when allowing the positively-phrased, reverse-scored items to cross-load onto the prosocial factor.

In our study, the reverse-scored items in the modified five-factor model are loading primarily onto the positive construal factor, with smaller, secondary loadings onto their original factor. Similar findings have also been observed in previous research for some of the reverse-scored items (e.g., Du et al., 2008; van de Looij-Jansen et al., 2011). This suggests that while the reverse-scored items are reflecting difficulties in our sample, they are also primarily reflecting a way of responding to positively-worded statements. It is also noteworthy that with the modified model, some of the reverse-scored items have trivial or non-significant loadings onto their original factor. In particular, the item ‘good friend’ on the peer problems subscale and the item ‘reflective’ on the hyperactivity-inattention subscale have low loadings, indicating that these factors may not be fully or strongly capturing the specific attributes that these items are relating to. This may be due to the young age of the participants, as children around the age of 2 years are unlikely to have strongly developed peer relationships or higher-order cognitive abilities such as reflective thinking. Therefore, a lack of these attributes may not be considered ‘difficulties’, thus explaining the trivial loadings on the original difficulties subscales. Replications of our research are encouraged to determine whether similar results are found with other children in this age group. If low loadings for the two items mentioned above are found in other cohorts of 2 year olds, it may be pertinent to modify these specific items so that they are more appropriate for such a young age group.

We also found measurement invariance of this final modified five-factor model across child’s gender and area-level deprivation, indicating that mothers did not appear to

be interpreting the SDQ differently if they had a boy rather than a girl or if they came from different socioeconomic backgrounds. Full configural and metric invariance were found across mother's ethnicity, but only partial scalar invariance was found as the threshold for the item 'tempers' from the conduct problems subscale was non-invariant across ethnic groups. However, as scalar invariance was found for the remaining four items on the conduct problems subscale, any groups differences are likely to be genuine (Steenkamp & Baumgartner, 1998). Therefore, we can still make valid comparisons of the SDQ between ethnic groups.

Although we found support for the modified five-factor model and not the original five-factor model, we still examined the internal consistency, means and bandings of the prosocial behaviour subscale, and its correlation with other subscales. This was done to maintain consistency with the literature.

Cronbach's alpha and MIC coefficients indicated that SDQ measures for 2 year olds generally showed good internal consistency. Four of the five subscales and the total difficulties score all obtained alpha values greater than the recommended threshold of .70 (Nunnally et al., 1967). The peer problems subscale was the only measure that obtained a low Cronbach's alpha of .54. This low coefficient could be due to the non-significant factor loading for item 11 (good friend). However, removal of this item only marginally improved the alpha to .55. Furthermore, the MIC coefficient for this subscale, albeit low, met acceptable criteria (Piedmont, 2014). Low alphas for peer problems have been frequently reported in the SDQ literature (Doi et al., 2014; Du et al., 2008; R. Goodman, 2001; Hawes & Dadds, 2004; Matsuishi et al., 2008; Theunissen et al., 2013; Van Leeuwen et al., 2006; Woerner et al., 2004). While this may indicate that raters are not

interpreting the subscale items as reflecting the same underlying construct, our findings also suggest that the low alpha may be due to the short length of the subscale. Future studies should report both alpha and MIC values for SDQ measures, so as to determine whether low alpha coefficients for the peer problems subscale are due to the subscale length or the interpretation of the underlying construct.

We found moderate (positive) correlations between hyperactivity-inattention and conduct problems, between emotional symptoms and peer problems, between conduct problems and emotional symptoms and between conduct problems and peer problems. We also found a moderate (negative) correlation between total difficulties and prosocial behaviour. The strongest correlation was between the hyperactivity-inattention and conduct problems subscales. Previous studies on the SDQ have often reported stronger correlations between these two externalising subscales, relative to cross-scale correlations (Du et al., 2008; R. Goodman, 2001; Palmieri & Smith, 2007; van de Looij-Jansen et al., 2011).

When compared to the normative SDQ scores of preschool- and primary school-aged children from other populations (Hawes & Dadds, 2004; Iida et al., 2014; Kremer et al., 2015; Matsuishi et al., 2008; Youth in Mind, 2014), average effect sizes generally indicated that the mean scores for our sample differed only minimally on the emotional symptoms and prosocial behaviour subscales (data not shown). However, there were moderate to large differences present on the peer problems, conduct problems and hyperactivity-inattention subscales, and consequently on the total difficulties measure (data not shown); specifically, our sample obtained higher average scores on these measures. However, hyperactivity and behaviours measured by the conduct problems

subscale (e.g., temper tantrums, disobedience) are behaviours that have their onset during early childhood and tend to decrease in frequency with age (Biederman, 2005; Einon & Potegal, 1994; Jenkins, Owen, Bax, & Hart, 1984). Furthermore, key social skills and self-regulatory abilities necessary for peer interactions are still developing during toddlerhood (Rubin, Bukowski, & Parker, 2007). Consequently, the higher scores for the peer problems, conduct problems and hyperactivity-inattention measures in our sample may simply reflect age-related differences in behaviour. Alternatively, it is possible that NZ mothers rate their children more severely on the items for these subscales. Nevertheless, the cut-offs for the borderline and abnormal ranges in our sample were only marginally, if at all, different from what has been reported in older children (Bourdon, Goodman, Rae, Simpson, & Koretz, 2005; Matsuishi et al., 2008; Woerner et al., 2004; Youth in Mind, 2014) and recommended for 2 to 4 year olds on the SDQ website (Youth in Mind, 2014).

Our measurement invariance analyses indicated that we could make valid comparisons across child's gender, mother's ethnicity and area-level deprivation As such, we evaluated group differences in the difficulties measures from the SDQ. We found that boys showed greater peer problems, hyperactivity-inattention and total difficulties than girls, but these effects were too small to be of meaningful significance.

European mothers tended to give their children lower ratings on all measures, relative to mothers from the other ethnic groups. Higher SDQ scores were obtained by children born to mothers who identified as Māori and Pacific in particular, with moderate to large differences present. There is limited research on ethnic differences in child behaviour in NZ. Research with other populations has suggested that ethnic differences in

physical and psychological health are often due to differences in SES (D. R. Williams & Collins, 1995). Given that we also found differences in SDQ scores between children who came from different deprivation groups, this is also a possibility. However, these ethnic differences remained when we re-ran the analyses controlling for deprivation status (data not shown). Future research should investigate what factors may underlie these differences.

As noted above, differences in SDQ scores were found across socioeconomic groups. Specifically, children who came from more deprived (i.e., lower socioeconomic) areas tended to have greater scores for each of the difficulties subscales and consequently on the total difficulties scale. This difference was most pronounced and meaningful between children from the highest and lowest deprivation groups. The association between SES and behavioural and emotional problems in children is well documented. A systematic review by Reiss (2013) found that in 52 of the 55 studies reviewed, lower SES was associated with greater behavioural and emotional problems, measured primarily by the SDQ and Child Behaviour Checklist (CBCL; Achenbach, 1991; Achenbach & Edelbrock, 1983), in both children and adolescents. These findings add further support to a broad literature base that highlight the importance of reducing socioeconomic inequalities in the population.

Unlike several other studies (Becker et al., 2004; Croft et al., 2015; Du et al., 2008; Ezpeleta, Granero, et al., 2013; R. Goodman, 2001; Hawes & Dadds, 2004; He et al., 2013; Van Leeuwen et al., 2006), we were unable to validate the SDQ against another tool, such as the CBCL, or against formal clinical diagnoses. However, with large multidisciplinary longitudinal studies like *Growing Up in New Zealand*, obtaining such

information is not always feasible. Administering longer questionnaires such as the CBCL can be time-consuming, expensive, and may even reduce response or completion rates (Edwards et al., 2002; Galesic & Bosnjak, 2009). While we do have information on any clinical diagnoses given to children in the *Growing Up in New Zealand* study, very few children had been diagnosed with any behavioural or emotional disorders by the age of 2 years. However, this is unsurprising, given the young age of our cohort. Therefore, the preschool SDQ is better used as a screening tool to identify young children who need a more thorough clinical assessment and may benefit from intervention. As more diagnostic information becomes available in future data collection waves, additional research should aim to examine the long-term predicative validity of the preschool SDQ by investigating whether preschool SDQ scores are predictive of children's likelihood of being diagnosed with an emotional or behavioural disorder in later childhood or adolescence.

There were several strengths to this study, particularly the size and age of the sample when the SDQ was administered. The large sample size would have not only increased statistical power, but also ensured that group numbers were large enough to test for measurement invariance of the model across child's gender, mother's ethnicity and deprivation. To date, the parent-rated preschool SDQ has only been validated in children as young as 3 years, thus this was the first study to evaluate the psychometric properties of the questionnaire in 2 year old children. For an instrument such as the SDQ to be administered in a particular age group, it needs to show adequate reliability and validity within that age group. Therefore, this study is a crucial and necessary contribution to the literature, as studies have already used the SDQ to screen for behavioural and emotional

problems in children between the ages of 2 and 3 years (e.g., Sim et al., 2013), despite a lack of evidence to support its use. We encourage replication studies in other populations with a similar age group, to broaden the evidence on the preschool SDQ and add further support for its reliability and validity in children as young as 2 years.

It is worth noting that this is the first study to establish normative scores and bandings for the SDQ in a NZ population. The *Growing Up in New Zealand* study has recently administered the standard parent-rated SDQ in the cohort at 4.5 years, and aims to administer not only the parent-rated questionnaire, but the teacher- and self-report versions in future relevant data collection waves. This will enable us to provide normative information for the NZ population at several ages and for several informants, and also allow us to investigate the developmental trajectories of the SDQ measures.

Overall, we found support for a modified five-factor model, which accounted for a positive construal factor, for the parent-rated preschool SDQ in 2 year old NZ children. In our study, SDQ measures generally had good internal consistency. We also found satisfactory measurement invariance across child's gender, mother's ethnicity and area-level deprivation. However, caution should be taken with the peer problems subscale, as this subscale had lower internal consistency values and had an item with a non-significant factor loading. We found that children born to Māori and Pacific mothers and children from higher deprivation areas were more likely to receive higher scores on difficulties measures. Future research should explore what factors explain these differences. Studies should also investigate the predictive validity of the preschool SDQ to determine whether high scores during early childhood are predictive of later behavioural or emotional problems. We recommend that the preschool SDQ, particularly the difficulties subscales

and total difficulties measures, be used as a screening instrument to identify children in current need of a more thorough assessment, so that their families are provided with appropriate assistance in improving their child's psychosocial or behavioural adjustment.

2B. The Strengths and Difficulties Questionnaire: Factor structure of the father-report and parent agreement in two year old children (Study 2)

2B.1 Abstract

There is limited research on the preschool version of the Strengths and Difficulties Questionnaire (SDQ), and comparisons between mothers and fathers as informants and whether the factor structure shows measurement invariance across parents is lacking. Our study involved mothers (n=6246) and fathers (n=3759) of 2-year-old children from the *Growing Up in New Zealand* birth cohort. Confirmatory factor analysis was used to evaluate the factor structure of the SDQ and test for measurement invariance across mothers and fathers. For fathers, we found support for a modified five-factor model that accounts for a positive construal method effect. Internal consistency was good for measures except peer problems. Full measurement invariance of this modified model was found across mothers and fathers, and parents showed moderate agreement in their SDQ ratings ($0.34 \leq r \leq 0.44$). More research is needed on whether mother- and father-reports differ in sensitivity when screening for early childhood psychiatric disorders.

2B.2 Introduction

When identifying children with behavioural and emotional difficulties, parents are often used as informants on screening questionnaires such as the Strengths and Difficulties Questionnaire (R. Goodman, 1997). The early use of such questionnaires is vital, as psychiatric disorders can occur from early in childhood (Egger & Angold, 2006). Young children with psychosocial difficulties can also show a continuity in symptoms and are at greater risk of negative health outcomes later in life (Bardone et al., 1998;

Bittner et al., 2007; Caspi et al., 1996; Costello, Mustillo, Erkanli, Keeler, & Angold, 2003; Fergusson et al., 2005; Fergusson & Lynskey, 1998; Hofstra et al., 2002; Odgers et al., 2007). As such, screening questionnaires need to be psychometrically sound. Importantly, in instances where parents are used as informants, it is necessary to consider whether measures used show consistent validity and reliability across both mothers and fathers.

The SDQ is a 25-item behaviour screening questionnaire for children and adolescents. It consists of four difficulties subscales (emotional symptoms, peer problems, hyperactivity-inattention and conduct problems), and a prosocial behaviour subscale. A measure of total difficulties can also be calculated by summing all difficulties subscales. The questionnaire includes ten positively worded items (all items for the prosocial behaviour subscales and five reverse-scored items from the difficulties subscales), with all other items worded negatively. The standard parent-report version can be used with children aged 4 to 17 years, with a modified preschool version also available for use with children aged 2 to 4 years (Youth in Mind, 2014). There is extensive research on the psychometric properties of the standard parent-rated SDQ (Becker et al., 2004; Dickey & Blumberg, 2004; Du et al., 2008; R. Goodman, 2001; Hawes & Dadds, 2004; He et al., 2013; Hill & Hughes, 2007; Matsuishi et al., 2008; Mellor & Stokes, 2007; Smits, Theunissen, Reijneveld, Nauta, & Timmerman, 2016; Van Leeuwen et al., 2006; Van Roy et al., 2008; Woerner et al., 2004), and to a lesser extend the preschool version (Croft et al., 2015; Doi et al., 2014; D'Souza, Waldie, Peterson, Underwood, & Morton, 2017a; Klein et al., 2013; Theunissen et al., 2013). Teacher- and self-report versions have also been developed for use in appropriate age groups.

Studies investigating the agreement between mothers and fathers on the SDQ have typically evaluated correlations and differences in children's scores between parents. Using Pearson or Spearman's correlation coefficients, moderate to large correlations between parents' SDQ scores have been observed for children aged 4 to 9 years (*r* range: 0.37 – 0.64; (Borg, Kaukonen, Salmelin, Joukamaa, & Tamminen, 2012; Davé, Nazareth, Senior, & Sherr, 2008; Mellor, Wong, & Xu, 2011). Similar results have been found in older children and adolescents (Griffith, Hastings, & Petalas, 2014).

When looking at differences in children's SDQ scores between mothers' and fathers' ratings, mixed results have been found. In siblings of individuals with autism spectrum disorder, Griffith et al. (2014) found no differences in the scores from mothers and fathers on all difficulties measures, though mothers reported greater prosocial behaviour in their children than fathers. Similar results were also found when looking at mothers' and fathers' ratings of SDQ measures for Chinese children (Mellor et al., 2011). However, in a sample of 4 to 6 year olds, higher scores were reported by fathers on the hyperactivity-inattention and conduct problems subscales, as well the total difficulties score (Davé et al., 2008).

The mixed findings in the studies reported above could be explained by the age range of the studies' samples. While the sample used by Griffith et al. (2014) included younger children, the age range of participants was broad and extended to late adolescence. Additionally, Mellor et al.'s (2011) sample included older primary school-aged children. It is possible that mothers of younger children, such as those in the study by Davé et al. (2008), rate their child as having fewer difficulties than fathers. They may be more used to difficult behaviours in their children as a result of spending more time

with their child in the early years than fathers (Craig, 2006). However, time spent with their child tends to decrease in both mothers and fathers as children get older (Åman-Back & Björkqvist, 2004). This may result in similar scores between parents, as mothers may be less exposed to their children's difficult behaviours. Indeed, there does appear to be evidence that the agreement between parents' scores increase as child's age increases (Duhig, Renk, Epstein, & Phares, 2000). Therefore, differences may be expected in mothers' and fathers' scores of their child, particularly on measures of behavioural difficulties, if their child is of preschool age or younger.

When evaluating agreement between mothers' and fathers' ratings on the SDQ, it is also important to consider measurement invariance of the questionnaire's factor structure across both parents. The factor structure of the parent-report version of the SDQ has been thoroughly investigated in 2 to 19 year olds, generally using SDQ responses from an unspecified parent or just mothers (Becker et al., 2004; Croft et al., 2015; D'Souza et al., 2017a; Du et al., 2008; Ezpeleta, Granero, et al., 2013; R. Goodman, 2001; Hawes & Dadds, 2004; He et al., 2013; Hill & Hughes, 2007; Klein et al., 2013; Stone et al., 2013; Van Leeuwen et al., 2006; Van Roy et al., 2008). Several of these studies have tested Goodman's (1997) five-factor structure, though some studies (e.g., Croft et al., 2015; Dickey & Blumberg, 2004; Klein et al., 2013; Riso et al., 2010; Van Leeuwen et al., 2006) have also investigated a three-factor model comprising of an internalising factor consisting of some items relating to peer problems and emotional symptoms; an externalising factor consisting of items relating to hyperactivity-inattention and conduct problems; and a prosocial factor, which consists of the prosocial items and some of the positively-worded reverse scored items. In general, studies that compared the

two models showed that the three-factor model was a poorer fit than the five-factor model (Croft et al., 2015; Klein et al., 2013; Van Leeuwen et al., 2006).

However, similar to the three-factor model, there is also evidence from exploratory factor analysis that the positively-worded reverse-scored items cross-load onto the prosocial subscale with the five-factor model (Du et al., 2008; R. Goodman, 2001; Hawes & Dadds, 2004), indicating that there may be a positive construal method effect present; that is, that this 'positive construal factor' may be reflecting informants' willingness to attribute positive qualities (R. Goodman, 2001). Further support for the presence of a positive construal factor has come from studies that have used confirmatory factor analysis (CFA) to compare Goodman's (1997) original five-factor model to a model that accounts for this positive construal response style. In an earlier evaluation of the mother-report of the preschool SDQ in 2 year old New Zealanders, we found unsatisfactory model fit for the original five-factor model, but improved and satisfactory fit in a model that allowed positively worded items to cross-load onto the prosocial factor (D'Souza et al., 2017a). Model fit was also improved when accounting for a positive construal factor in a sample of older children and adolescents (Van Roy et al., 2008), and with the self-report version of the SDQ (van de Looij-Jansen et al., 2011).

Studies that use SDQ scores from an unspecified parent or compare scores from both parents are assuming that the SDQ factor structure shows measurement invariance across both mothers and fathers; that is, that mothers and fathers are interpreting the SDQ in the same way, and that factors are measuring the same underlying constructs across both parents. However, only one study thus far has investigated the factor structure in fathers' report of the SDQ, and evaluated measurement invariance of the factor structure

across mothers and fathers (Chiorri, Hall, Casely-Hayford, & Malmberg, 2016). Using exploratory structural equation modelling, Chiorri et al. found support for the five-factor model with both mothers' and fathers' reports of the SDQ in 51 month old children. However, similar to studies using exploratory factor analyses (Du et al., 2008; R. Goodman, 2001; Hawes & Dadds, 2004), the study found that most of the reverse-scored items had substantial cross-loadings onto the prosocial behaviour subscale, indicating that these items may reflect more than one latent construct. Chiorri et al. also demonstrated measurement invariance of this model across both mothers and fathers.

To our knowledge no study has yet evaluated the factor structure of a preschool SDQ rated by fathers, and measurement invariance of this preschool version across mothers and fathers have not yet been assessed; as such, the current study addressed this gap in the literature. Mother- and father-rated SDQ data was obtained for a sample of 2 year old New Zealand (NZ) children. As noted above, we have previously evaluated the psychometric properties, including the factor structure, of the mother-rated preschool SDQ for this cohort and found support for a modified model that accounted for a positive construal factor (D'Souza et al., 2017a). Thus, our aim was to investigate whether these results were replicated using the father-rated SDQ data.

Given that past research with both mother- and self-rated SDQ data (D'Souza et al., 2017a; van de Looij-Jansen et al., 2011) has found superior model fit with a modified model that accounts for a positive construal factor, we hypothesise that this modified model will also show better fit than Goodman's (1997) original model when using the father-rated SDQ. If our hypothesis is supported, measurement invariance of the modified model will be assessed across both mothers and father. We will also evaluate

the agreement between mothers' and fathers' SDQ scores of their child. If measurement invariance is satisfactorily established, mean differences in the scores from mothers and fathers will be investigated.

2B.3 Methods

2B.3.1 Participants

Participants were mothers and fathers of children from the longitudinal *Growing Up in New Zealand* study. The prospective study follows a socioeconomically and ethnically diverse cohort of NZ children that were recruited via 6822 pregnant mothers who had expected delivery dates between 25th April 2009 and 25th March 2010. A detailed description of the study's design and recruitment is provided elsewhere (Morton et al., 2013; Morton, Grant, et al., 2014). Briefly, pregnant mothers were recruited from the geographical area covered by three contiguous District Health Board regions, which contains approximately one third of the NZ birth population (Morton et al., 2013). In general, statistics for mothers on key parameters such as mother's age, ethnicity, parity and socioeconomic status were comparable to those of all NZ parents (Morton et al., 2013), and children within the cohort are broadly generalizable to current NZ births (Morton et al., 2015). Recruited pregnant women were asked to provide contact information for a partner, defined as someone whom they were in a 'significant social relationship with' (Pryor et al., 2014). A total of 4401 partners consented to participate in the study. So as to remain consistent with the literature, as past research has generally focused on fathers (as opposed to mothers' partners in general), the current study will only include data from fathers of the children. In this article, a father is defined as someone who identifies themselves as male and is either the biological, adoptive or

stepfather of the child. At the 9 month data collection wave, information on partners' gender and relationship to the child was obtained. Overall, 4074 partners were identified as fathers, with 4062 being biological fathers and 12 being either adoptive or stepfathers. Partners that were excluded from the analyses included 13 partners who identified as female, 1 partner who identified as another family member, and 4 who identified as 'other'. Several partners (*n*=309) did not respond at the 9 month data collection wave, and were therefore also excluded from analyses as the nature of their relationship to the child was unknown.

Major data collection waves for the study have occurred during the late antenatal period, at 9 months and at 2 years, using computer assisted personal interviews (CAPIs). Mothers and partners were interviewed separately, with 64% of the 2 year interviews being follow-ons (i.e. the partner's interview followed immediately after the mother or vice versa). Each data collection wave focuses on gathering information relating to six inter-connected domains of child development: health and wellbeing, family and whanau (extended family), culture and identity, education, psychosocial and cognitive development, and neighbourhoods and societal context. Ethical approval was granted from the Ministry of Health Northern Y Regional Ethics Committee (NTY/08/06/055), with written informed consent provided by both mothers and partners.

At 2 years, 6246 mothers and 3759 fathers completed the preschool SDQ. Children without father-rated SDQ data were more likely to come from high deprivation areas and have a mother of Māori or Pacific ethnicity, *ps* < .001. These children were also more likely to have higher scores at 2 years on all difficulties measures from the mother-rated SDQ when compared to children with father-rated data, *ps* < .001. Fathers who did

not provide SDQ data were also more likely to identify as Māori, Pacific or Asian ethnicity, $p < .001$.

2B.3.2 Measures

Strengths and Difficulties Questionnaire. Mothers and fathers independently answered the English (UK) version of the parent-rated preschool SDQ, which was developed for children between the ages of 2 and 4 years (R. Goodman, 1997). The 25-item questionnaire is designed to measure five subscales (emotional symptoms, peer problems, hyperactivity-inattention, conduct problems and prosocial behaviour). All subscales except prosocial behaviour can be summed to give a measure of total difficulties. Three items have been modified in the preschool version of the questionnaire, relative to the standard version, so that it is more appropriate for preschool children. On the conduct problems subscale, the items ‘often lies and cheats’ and ‘steals from home, school or elsewhere’ have been modified to ‘often argumentative with adults’ and ‘can be spiteful to others’, respectively; on the hyperactivity subscale, the item ‘can stop and think things out before acting’ has been changed to ‘thinks things out before acting’. A 3-point Likert scale was used to rate each item, with response scores of 0 for *not true*, 1 for *somewhat true* and 2 for *certainly true*. Positively-worded items from the difficulties subscales were reverse-coded. Higher scores reflect greater difficulties or greater prosocial behaviour. Previous research with the mother-report has shown generally good internal consistency for the original subscales and total difficulties score within this cohort (D’Souza et al., 2017a).

2B.3.3 Data Analysis

Confirmatory factor analysis (CFA) was used to test two *a priori* models with the father-rated SDQ: the original five-factor proposed by Goodman (1997), and the modified five-factor structure identified as the best-fitting model by van de Looij-Jansen et al. (2011) and D'Souza et al. (2017a). This modified model accounted for a positive construal response style by allowing cross-loadings of positively-worded, reverse-scored items onto the prosocial behaviour subscale. SDQ items were treated as ordinal variables, due to being measured on a 3-point Likert scale.

Robust diagonal weighted least squares (DWLS) estimation was used with the CFA analyses. This is because DWLS estimation is more appropriate for ordinal data than maximum likelihood (ML) estimation, as the latter assumes that the observed variables follow a multivariate normal distribution (Li, 2016). With robust DWLS estimation in the current study, thresholds and polychoric correlations are estimated using maximum likelihood (Li, 2016). Robust standard errors and a mean- and variance-adjusted test statistic are then calculated using the estimated asymptotic covariance matrix of the thresholds and polychoric correlations in a weight matrix, and model parameters are obtained using the diagonal weight matrix (Li, 2016; Rosseel, 2012).

Scales were set for latent variables using the marker variable strategy. The comparative fit index (CFI), Tucker-Lewis index (TLI), gamma hat and root mean square error of approximation (RMSEA) were used to evaluate model fit. CFI and TLI values of around .90 or greater, gamma hat values of approximately .95 or greater and RMSEA values less than .06 indicate acceptable model fit (Bentler, 1990; Hu & Bentler, 1999).

It was planned that measurement invariance of the model would be assessed if the best fitting model for the father-rated SDQ was consistent with what has been found with the mother-report within this sample (i.e. the modified five factor mode; (D'Souza et al., 2017a). To test for measurement invariance, latent factors were modelled separately for mothers and fathers and nested within the child. Latent factors were correlated between mothers and fathers, and corresponding items' residuals were correlated (e.g., the residual for item 1 from the mother-report was correlated with the residual for item 1 from the father-report). Configural, metric and scalar invariance was tested. Firstly, factor loadings and thresholds were free to vary across mothers and fathers (Model 1). This configural invariance test examines whether the same configuration holds across groups. Following this, factor loadings were constrained to be equal across groups, but thresholds were free to vary across mothers and fathers (Model 2). This metric or weak invariance test examines whether respondents from the two groups attribute the same meaning to the latent SDQ factors. Finally, factor loadings were also constrained to be equal across mothers and fathers (Model 3). This scalar or strong invariance test examines whether the interpretation of the latent factor (factor loadings) and the level of endorsement of the items (intercepts) are equal in both groups and hence whether both groups can be compared on their latent factor scores. Researchers have typically used ΔCFI as an index of difference in fit between two samples with increasing levels of model constraint.). Models are considered to not significantly differ, and demonstrate invariance, if ΔCFI is equal to or less than 0.01 (Cheung & Rensvold, 2002).

Cronbach's alpha was used to evaluate the internal consistency of the father-rated SDQ subscales and total difficulties score. Mean inter-item correlation (MIC) coefficients

were also used to assess internal consistency, as Cronbach's alpha calculations can be influenced by short subscale length (Nunnally & Bernstein, 1994; Streiner, 2003). Alpha coefficients of .60 and above are considered acceptable in SDQ literature (Hawes & Dadds, 2004; Matsuishi et al., 2008; van de Looij-Jansen et al., 2011; Van Leeuwen et al., 2006; Woerner et al., 2004). MIC coefficients of .20 and above are recommended (Nunnally & Bernstein, 1994; Piedmont, 2014). Due to the ordinal nature of SDQ items, calculations of alpha and inter-item coefficients were based on polychoric correlations.

Similar to previous studies (Borg et al., 2012; Davé et al., 2008; Griffith et al., 2014; Mellor et al., 2011), Pearson and Spearman's correlation coefficients were used to evaluate the agreement between scores reported by mothers and fathers. If measurement invariance of the modified five-factor model is found across mothers and fathers, mean differences in SDQ subscale and total difficulties scores will be investigated using paired sample t-tests. Effect sizes for mean differences were determined using Cohen's *d* (J. Cohen, 1988).

CFA, measurement invariance analyses and Cronbach's alpha calculations were conducted in R, using the statistical packages lavaan (Rosseel, 2012) and semTools (Pornprasertmanit et al., 2013). All other analyses were performed using IBM SPSS Statistics version 22. Statistical significance was set at an alpha level of .05.

2B.4 Results

2B.4.1 Confirmatory Factor Analysis

Model fit indices did not meet recommended criteria for the original five-factor model, $\chi^2_{(265)}$ = 4215.90; CFI = .755; TLI = .723; Gamma hat = .915; RMSEA = .068. Improved and acceptable model fit was found for the modified five-factor model, $\chi^2_{(260)}$ =

1891.66; CFI = .899; TLI = .883; Gamma hat = .966; RMSEA = .044. Standardised factor loadings for the original and modified five-factor models are presented in Table 2B.1. All factor loadings were significant for the original five-factor model, *ps* < .05. With the modified model, near zero loadings were observed for item 11 (good friend) on the peer problems subscale, and item 21 (reflective) on the hyperactivity-inattention subscale. The loading for item 21 also did not reach significance. All other items had significant factor loadings, *ps* < .05.

2B.4.2 Measurement Invariance

As the modified five-factor model showed superior model fit with the father-report of the SDQ, replicating what has been found previously with the mother-report (D'Souza et al., 2017a), measurement invariance of this model across mothers and fathers was tested. Model fit indices, including CFI and ΔCFI, for Models 1, 2 and 3 are provided in Table 2B.2. Configural, metric and scalar invariance were supported, as constraining factor loadings and then factor thresholds to be equal across mothers and fathers resulted in ΔCFI of less than 0.01 when compared to less constrained models. This suggest that the interpretation of the SDQ factors (the factor loadings), and the level of endorsement of the underlying items are equal in both mothers and fathers and hence the groups can be compared on their SDQ latent scores.

2B.4.3 Internal Consistency

Table 2B.3 presents Cronbach's alpha and MIC values for father-rated SDQ subscales (including both the original prosocial behaviour subscale and the modified positive construal factor) and total difficulties. Table 2B.3 also provides alpha and MIC coefficients for mother-rated SDQ data, as reported by us in D'Souza et al. (2017a).

D'Souza et al. did not calculate alpha and MIC coefficients for the positive construal factor, so this has also been provided. Father-rated peer problems had the lowest Cronbach's alpha and MIC values, $\alpha = 0.50$; MIC = 0.17. Cronbach's alpha and MIC coefficients were satisfactory for all other father-rated SDQ measures, $\alpha > 0.60$; MIC > 0.20. Father-rated total difficulties obtained an alpha value of 0.82 and MIC coefficient of 0.28.

2B.4.4 Agreement between Mother and Fathers

Correlations between SDQ scores reported by mothers and fathers are presented in Table 2B.3. In general, significant moderate correlations were found for all SDQ measures, Pearson $r > 0.30$, *ps* < .001 for all. Amongst the subscales, conduct problems had the strongest correlation, Pearson $r = 0.43$. Total difficulties obtained a Pearson correlation coefficient of 0.44. '

2B.4.5 Mean Differences between Mother- and Father-Rated Scores

Mean scores for both mother- and father-rated SDQ subscales and the total difficulties score are presented in Table 2B.3. As comparisons were conducted between mother- and father-ratings, mean scores provided for mother-rated SDQ measures are based on children with father-rated SDQ scores. Paired sample *t*-tests revealed that fathers reported significantly higher emotional symptoms, hyperactivity-inattention and total difficulties than mothers, *ps* < .05 for all. Mothers reported significantly higher scores on the original prosocial subscale when compared to fathers, $p < .05$. No other differences were significant, and all significant mean differences were negligible in size, $0.04 \leq d \leq 0.07$.

Table 2B.1.
Standardised factor loadings for the original and modified five-factor models of the father-rated SDQ

	Original Model					Modified Model				
Item	Emotional Symptoms	Peer Problems	Hyperactivity-Inattention	Conduct Problems	Prosocial Behaviour	Emotional Symptoms	Peer Problems	Hyperactivity-Inattention	Conduct Problems	Positive Construal
3. Somatic	0.59					0.6				
8. Worries	0.63					0.64				
13. Unhappy	0.75					0.73				
16. Clingy	0.43					0.43				
24. Fears	0.54					0.54				
6. Solitary		0.35					0.43			
11. Good friend*		0.31					0.06			-0.34
14. Popular*		0.52					0.18			-0.48
19. Bullied		0.54					0.68			
23. Best with adults		0.36					0.46			
2. Restless			0.60					0.62		
10. Fidgety			0.69					0.74		
15. Distractible			0.65					0.69		
21. Reflective*			0.39					.04[a]		-0.5
25. Persistent*			0.48					0.23		-0.38
5. Tempers				0.6					0.62	
7. Obedient*				0.5					0.23	-0.45
12. Fights				0.67					0.69	
18. Argues				0.61					0.64	
22. Spiteful				0.57					0.59	
1. Considerate					0.72					0.68
4. Shares					0.54					0.54
9. Caring					0.6					0.59
17. Kind to kids					0.62					0.61
20. Helps out					0.48					0.52

Note: * reverse-scored items; [a] factor loading $p > .05$.

Table 2B.2.
Fit indices for invariance analyses for the modified five-factor model across mothers and fathers

	X^2	*df*	RMSEA	Gamma hat	TLI	CFI	ΔCFI[a]
1. Configural invariance	4276.56	1095	0.031	0.957	0.894	0.905	
2. Metric invariance	4146.94	1116	0.03	0.956	0.901	0.909	0.004
3. Scalar invariance	4346.51	1161	0.03	0.954	0.899	0.905	0.004

Note: [a] ΔCFI = CFI of constrained model – CFI of less constrained model. Only the absolute value is given.

Table 2B.3.
Internal consistency, mother-partner agreement and mean scores for each SDQ measure

	Cronbach's alpha (MIC)		Pearson *r*	Mean scores (*SD*)		
Scale	Mother[a]	Father	(Spearman's *r*)	Mother[c]	Father	*t*
Emotional Symptoms	0.75 (0.37)	0.71 (0.34)	0.39 (0.38)**	1.61 (1.47)	1.73 (1.48)	4.60**
Peer Problems	0.54 (0.20)	0.50 (0.17)	0.36 (0.35)**	2.01 (1.62)	2.00 (1.55)	0.29
Hyperactivity-Inattention	0.71 (0.33)	0.68 (0.29)	0.35 (0.35)**	4.17 (2.13)	4.26 (2.00)	2.30*
Conduct Problems	0.74 (0.36)	0.71 (0.33)	0.43 (0.41)**	2.86 (1.86)	2.86 (1.81)	0.12
Original Prosocial Subscale[b]	0.71 (0.33)	0.73 (0.35)	0.34 (0.34)**	7.11 (1.85)	6.99 (1.86)	3.34**
Positive Construal Factor	0.79 (0.27)	0.79 (0.27)	0.34 (0.33)**	13.88 (3.03)	13.80 (3.03)	1.54
Total Difficulties	0.84 (0.31)	0.82 (0.28)	0.44 (0.43)**	10.65 (4.80)	10.85 (4.64)	2.39*

Note: *$p < .05$; ** $p < .001$.
[a] Cronbach's alpha and mean inter-item correlation (MIC) coefficients for all mother-reported SDQ measures, excluding the positive construal factor, were obtained from D'Souza et al. (2017).
[b] Results are presented for the prosocial behaviour subscale to remain consistent with the literature.
[c] Mean scores for mother-rated SDQ measures are based on the scores of children with father-rated SDQ scores (N = 3759)

2B.5 Discussion

The current study evaluated the factor structure and internal consistency of a father-rated preschool SDQ in 2 year old NZ children. The factor structure and internal consistency of the preschool SDQ, rated by the children's mothers, was assessed previously by D'Souza et al. (2017a). Measurement invariance of the factor structure across mothers and fathers was also evaluated, as well as the agreement and differences between mothers' and fathers' ratings for each SDQ measure. This study is an important contribution to the literature, as it not only adds to limited research on the preschool version of the SDQ, it also addresses significant gaps in the literature by evaluating the psychometric properties of the father-rated preschool SDQ and its agreement with the mother-rated version.

Similar to our procedure used earlier (D'Souza et al., 2017a), here we evaluated Goodman's (1997) original five-factor model, as well as a modified five-factor model, which included a positive construal factor. This modified model accounted for a possible positive construal method effect by allowing positively-worded reverse-scored items to cross-load onto what was originally the prosocial factor. The results supported our hypothesis, and replicated what we found with the mother-rated SDQ. Specifically, we found poor model fit for the original five-factor model, but improved and acceptable model fit with the modified five-factor model. Similar findings have also been shown with the self-report version of the SDQ in an older sample (van de Looij-Jansen et al., 2011). These results indicate that more investigation is needed with the SDQ, and future studies should assess both the original and modified models to evaluate whether an improved fit with the modified model is a consistent finding.

It is important to note that with the modified five-factor model, reverse-scored items have primary loadings onto the positive construal factor and smaller loadings onto their original factor. Near zero loadings were also found for the items ‘good friend’ and ‘reflective’ on the peer problems and hyperactivity-inattention subscales, respectively. Similar results were observed with this sample when evaluating the mother-report of the SDQ (D’Souza et al., 2017a). These findings suggest that while some reverse-scored items are indicators of difficulties in this cohort, they appear to be predominantly reflecting the positive construal factor. The age of the cohort could explain why trivial and/or non-significant loadings were observed for the same two items on their original difficulties subscales, with both mother- and father-rated data. Strong friendships and advanced cognitive abilities such as reflective thinking are unlikely to have developed in children as young as 2 years, therefore the characteristics that these items are measuring likely do not reflect ‘difficulties’ within this age group. Modification of these items may be necessary if low loadings are found in other samples of 2 year old children.

While our findings seem to support the presence of a positive construal method effect, there is a possibility that this positive construal factor can still be used as a measure of prosocial behaviour. As noted by D’Souza et al. (2017a), the reverse-scored items still reflect socially desirable behaviours that are important for prosociality, and van de Looij-Jansen et al. (2011) have suggested that the positive construal factor may reflect agreeableness and dutifulness with the self-report version of the SDQ. Recent research with the *Growing Up in New Zealand* cohort (Peterson et al., 2018) has investigated the association between temperament at 9 months and the 2 year mother-report of the positive construal factor. Temperamental factors such as high orienting and regulatory

control, high positive affect/surgency, high affiliation and low negative emotionality, which have been associated with prosocial behaviour in other studies (Eisenberg et al., 1996; Rothbart, 2011; Rothbart & others, 1994), were found to be significantly associated with the mothers' report of the positive construal factor at aged 2. However, evaluations of the relationship between the positive construal factor and direct measures of prosocial behaviour are still needed.

As the modified five-factor model was found to be the better fitting model for both the mother-report (D'Souza et al., 2017a) and the father-report of the SDQ, measurement invariance analyses were performed to evaluate whether mothers and fathers were interpreting and responding to the questionnaire in the same way. Our results showed that configural, metric and scalar invariance was found across mothers and fathers, supporting measurement invariance of the modified five-factor model. Previous research with the mother-report has also found full measurement invariance of this model across child's gender and SES, as well as partial but satisfactory measurement invariance across mother's ethnicity (D'Souza et al., 2017a).

Internal consistency was calculated for the father-rated SDQ measures, specifically for all original subscales, the positive construal factor and the total difficulties score. The internal consistency of the mother-rated SDQ subscales and total difficulties score was previously evaluated by D'Souza et al. (2017a). We calculated the internal consistency of the original prosocial factor to remain consistent with the literature, though caution should be used when interpreting this finding as our CFA analyses do not support its use. Our results were generally consistent with what was found with the mother-rated SDQ, specifically that four of the original five SDQ

subscales (emotional problems, hyperactivity-inattention, conduct problems, prosocial behaviour) and the total difficulties score obtained acceptable Cronbach's alpha and MIC coefficients. We also calculated the internal consistency values of the mother- and father-reported positive construal factors, and found that both factors showed good internal consistency.

The peer problems subscale was the only measure to show poor internal consistency, with low alpha and MIC values of 0.50 and 0.17, respectively. A possible reason for this could be the near-zero loading of item 11, but removal of this item decreased the alpha coefficient to 0.47. Low alpha coefficients have been regularly reported for the peer problems subscale in past research (Doi et al., 2014; Du et al., 2008; R. Goodman, 2001; Hawes & Dadds, 2004; Matsuishi et al., 2008; Theunissen et al., 2013; Van Leeuwen et al., 2006; Woerner et al., 2004), though it was unclear from these studies whether this was due to the interpretation of the underlying construct or short subscale length (Nunnally & Bernstein, 1994; Streiner, 2003). In our earlier report (D'Souza et al., 2017a), we found a low alpha value but acceptable MIC coefficient for the mother-rated peer problems subscale, indicating that the low Cronbach's alpha may have just been due to short subscale length. However, as the MIC coefficient obtained for the father-rated peer problems subscale was less than the acceptable value of 0.20 (Nunnally & Bernstein, 1994; Piedmont, 2014), our results suggest that when fathers are used as raters, the peer problems subscale appears to show genuinely poor internal consistency, regardless of subscale length.

We found moderate correlations between mothers' and fathers' ratings on all SDQ measures. Moderate to large correlations between mothers' and fathers' ratings

have been found in previous research with the SDQ, with larger correlations typically observed for externalising measures such as conduct problems and hyperactivity-inattention (Borg et al., 2012; Davé et al., 2008; Griffith et al., 2014; Mellor et al., 2011). In our sample, the strongest correlations were found for total difficulties and conduct problems, though the agreement for the hyperactivity-inattention subscale was comparable to that of the other subscales. However, unlike past research, large correlations were not observed for any of the SDQ measures. This is likely due to the young age of the cohort, as the studies noted above have only been conducted with children aged 4 years or older. Indeed, a meta-analysis of studies assessing interparental agreement on measures of child behaviour found that agreement between parents gets stronger as children get older, with low to moderate agreement found for preschool children and moderate to strong correlations observed for those in middle childhood and adolescence (Duhig et al., 2000).

As expected, mothers and fathers differed in their child's SDQ ratings. Mothers generally gave their children lower scores on the emotional symptoms, hyperactivity-inattention, and total difficulties measures when compared to fathers. These differences could be due to mothers being more habituated to difficult behaviours in their children than fathers, likely as a result of spending more time with their children at this age (Craig, 2006). Nevertheless, these differences were notably small in magnitude and may therefore not be of any meaningful significance. Mothers also gave their children higher scores on the original prosocial behaviour subscale relative to fathers. However, as our factor analyses do not support the use of this subscale, we caution against interpreting this finding.

There are some limitations with the current study. We have not evaluated the sensitivity and specificity of the difficulties measures against formal clinical diagnoses, and whether this differs across mother- and father-reports, as very few children in the cohort have received diagnoses for disorders at such a young age. Additionally, although mothers and children from the *Growing Up in New Zealand* cohort were broadly generalisable to the current NZ population, the sample of fathers recruited is biased (Morton et al., 2010, 2013). In the current study, children without father-rated SDQ data were more likely to live in high deprivation areas, have a mother of Māori or Pacific ethnicity, and a father of Māori, Pacific or Asian ethnicity. Consequently, these particular groups are not adequately represented in our study. These children were also more likely to have higher mother-rated SDQ scores on all difficulties subscales, therefore the lack of father-rated data for these individuals may have skewed the current study's results, particularly when considering the agreement and differences between mothers' and fathers' ratings. Further, we were only able to make comparisons for children with mother- and father-rated data, which reduced our sample size.

It is also important to note that while mothers and fathers generally completed their interviews independently, 36% were not follow-on interviews (i.e. there was a gap in time between when mothers and fathers were interviewed), either due to parents not living within the same household or time constraints. Therefore we cannot rule out the possibility that parents may have discussed the contents of the interview within that time. However, given that a considerable amount of information was collected during the interviews, we believe that it is unlikely that one parent would have remembered enough

details about the SDQ to strongly influence the other parent's answers. Nevertheless, this is a limitation to be aware of.

In spite of these limitations, our results suggest that agreement was still satisfactory and consistent with what we would expect based on past research, and differences between mothers' and fathers' ratings were fairly small. Furthermore, few longitudinal studies collect behavioural data from both parents, or adequately consider the agreement between parents' ratings and measurement invariance of the tools used. Additionally, our study adds to rather limited research on the preschool version of the SDQ and, to our knowledge, is the first study to exclusively evaluate father-ratings of a preschool SDQ.

This study examined the factor structure and internal consistency of the preschool SDQ, measured in 2 year old children and completed by the children's fathers. Similar to the mother-rated preschool SDQ, we found support for a modified five-factor model, which accounts for a positive construal factor. Aside from the peer problems subscale, SDQ measures also showed good internal consistency. Importantly, we found measurement invariance of the modified five-factor model across mothers and fathers, suggesting that both informants are reporting the same types of strengths and difficulties. We also found moderate agreement in the ratings of mothers and fathers, and differences in parents' ratings were small. Therefore, our results suggest that clinicians and researchers can be justified in using just one parent or caregiver as an informant on the preschool SDQ, though the peer problems subscale from either parent should be used with caution. Nevertheless, the use of multiple informants is encouraged in general and, more specifically, more research is needed to determine whether the sensitivity and

specificity of these measures in screening for psychiatric illnesses differ across mothers and fathers.

3. Antenatal and postnatal determinants of behavioural difficulties in early childhood: Evidence from *Growing Up in New Zealand* (Study 3)

3.1. Chapter Prologue

The study detailed in the following chapter addressed the second research question of this thesis: What are the predictors of behavioural difficulties in 2 year olds? All SDQ difficulties measures were assessed, with analyses focusing on predicting the odds of falling into the abnormal range. It was decided that focusing on identifying risk and protective factors associated with falling within the abnormal range would be of greater practical significance, as this cut-off is used to screen for children with a likely psychiatric disorder (R. Goodman, Ford, et al., 2000; R. Goodman, Renfrew, et al., 2000; Ministry of Health, 2015b).

Predictors in the analyses were selected from the antenatal and postnatal period, and specifically related to the family context. These measures also fit well within the framework of Bronfenbrenner's (1979) bioecological model, with specific predictors and covariates identified within each system. Figure 3.1 indicates where the predictors of interest fit within the multiple systems of Bronfenbrenner's bioecological model. Predictors of interest included intrauterine measures (e.g. perinatal folate and multivitamin intake, as well as prenatal smoking, second hand smoke and alcohol exposure), maternal mental health (prenatal and postnatal), and family processes. Analyses also controlled for certain individual traits and variables relating to the child's macrosystem.

A version of Study 3 has been published by Springer Nature in *Child Psychiatry and Human Development*. Please see: D'Souza, S., Waldie, K. E., Peterson, E. R., Underwood, L., & Morton, S. M. (2018). Antenatal and Postnatal Determinants of Behavioural Difficulties in Early Childhood: Evidence from Growing Up in New Zealand. *Child Psychiatry & Human Development*, 1-16.

Supplementary material referred to in the study has been included in Appendix B.

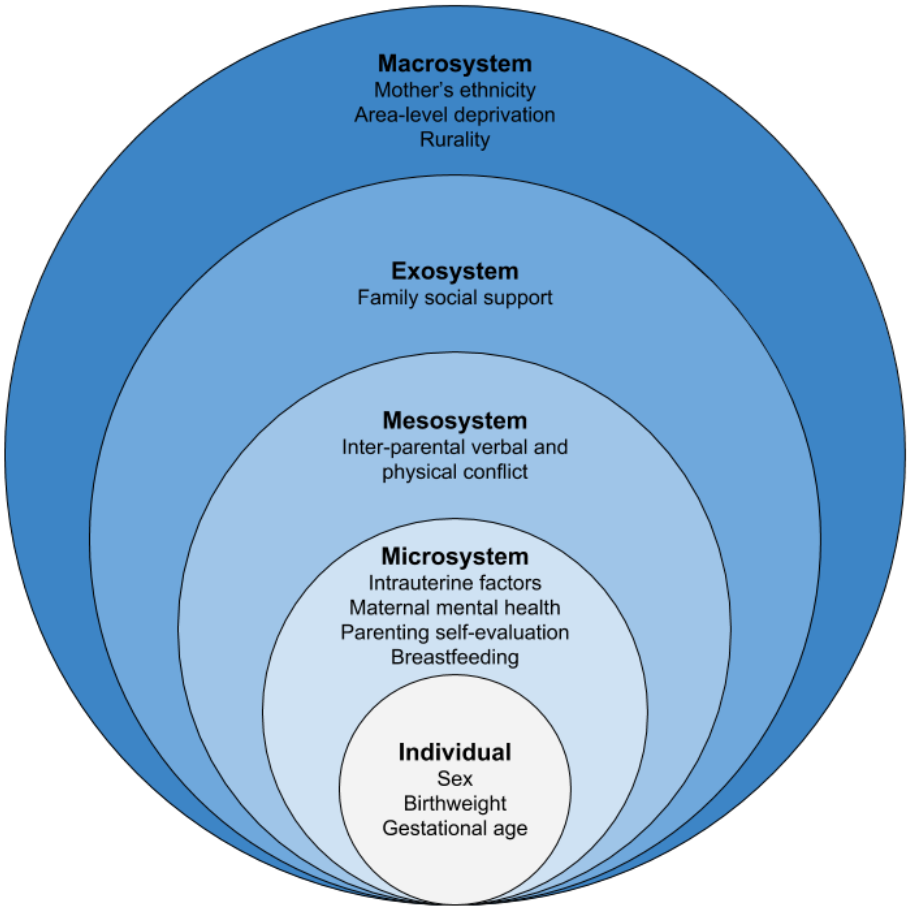

Figure 3.1. Indication of where predictors of interest from Study 3 fit within the ecological systems corresponding to Bronfenbrenner's (1979) bioecological model. Certain control variables are also displayed within the appropriate ecological systems.

3.2. Abstract

Behavioural difficulties during early childhood have significant implications for multiple outcomes later in life. Child behavioural difficulties at 2 years of age (N=6246) were assessed by mothers enrolled in a longitudinal, population-based New Zealand cohort study. 10.1% of children had total difficulties scores in the abnormal range on the preschool version of the Strengths and Difficulties Questionnaire. After controlling for maternal education, poverty and child's birth age/weight, several antenatal and postnatal maternal health and family risk factors were significant for: (i) emotional problems (antenatal maternal perceived stress, lack of periconceptional folate, and moderate to severe maternal postnatal anxiety); (ii) hyperactivity-inattention (antenatal maternal perceived stress, mothers' antenatal exposure to second hand smoke, moderate to severe maternal postnatal anxiety, and low maternal self-evaluation); (iii) conduct problems and total difficulties (antenatal maternal perceived stress, verbal inter-parental conflict and low maternal self-evaluation). The identification of risk and protective factors associated with early childhood difficulties are vital for guiding intervention and prevention efforts.

3.3. Introduction

Behavioural difficulties in early childhood can persist into adolescence and adulthood (E. D. Barker, Oliver, & Maughan, 2010; Goodwin, Fergusson, & Horwood, 2004; Reef, Diamantopoulou, Meurs, Verhulst, & Ende, 2010; White, Moffitt, Earls, Robins, & Silva, 1990), and research has shown that early behavioural problems can increase an individual's risk of adverse physical and mental health outcomes later in life (Bardone et al., 1998; Bittner et al., 2007; Fergusson & Horwood, 2001; Fergusson & Lynskey, 1998; Hayatbakhsh et al., 2008; Hofstra et al., 2002; Odgers et al., 2007). As

such, identifying modifiable factors that increase or reduce a child's risk of behavioural difficulties in early childhood is important in informing public health policies and preschool initiatives that aim to encourage optimal development over the lifespan (Ministry of Health, 2016; Nelson et al., 2003).

These risk or protective factors, particularly during the preschool years, occur within the context of a child's family (Nau & Heckert, 2013). Specifically, Nau and Heckert have noted that intrauterine biological factors and family processes, within the context of the family's social structure, are thought to be key mechanisms in influencing children's health and development. Below, we discuss potential factors relating to family processes that have been linked to child behaviour in previous research. Following that, under what is known as the foetal or developmental origins hypothesis (D. J. Barker, 1998), we discuss the link between child behaviour and several variables that may have an influence during the perinatal and postnatal period.

3.3.1. Family processes and childhood behavioural difficulties

Studies evaluating the influence of family processes on childhood behavioural difficulties often focus on improving the relationship between parent and child, as well as family support and dynamics (Dishion et al., 2008; Eyberg, Nelson, & Boggs, 2008; Rapee, Schniering, & Hudson, 2009; Shaw, Dishion, Supplee, Gardner, & Arnds, 2006; Webster-Stratton & Jamila, 2010; Webster-Stratton & Taylor, 2001). Studies with preschool-aged children in the United States (Fantuzzo et al., 1991) and in Australia (Bayer et al., 2008, 2012) have shown that children exposed to verbal and/or physical inter-parental conflict early in development are at a greater risk of displaying subsequent internalizing or externalizing behavioural difficulties. However, the level of social

support available to the family may be protective against behavioural difficulties. Having a greater support network has been linked to improved parenting and greater family resilience in adverse circumstances, which may in turn improve child outcomes (Armstrong et al., 2005; Black & Lobo, 2008). As such, it is important to directly evaluate whether factors such as supportive extended family members and friends, and an availability of supportive community and agency resources, are beneficial for children's behavioural development.

Further, mother's perceived self-efficacy and evaluation of themselves as a parent have been associated with beneficial developmental outcomes in children. Coleman and Karraker (2003) found that while a mother's perceived self-efficacy was not a significant predictor of observed parenting competence, increased self-efficacy was still associated with greater mental development in toddlers (using the mental scale from the Bayley Scales of Infant Development [BSID-II] (Bayley, 1993), increased compliance and affection towards the mother, as well as low avoidance and low negativity in the child. In support of this, earlier cross-sectional research with our cohort found that perceived parenting confidence and satisfaction (elements of parenting self-efficacy) were related to low negativity and high positive affectivity/surgency in infants at 9 months (Peterson et al., 2017). There is also evidence that high maternal perceived self-efficacy is correlated with fewer behavioural problems, greater socio-emotional functioning and better adjustment in older children (Johnston & Mash, 1989; Jones & Prinz, 2005).

3.3.2. Perinatal and postnatal factors and childhood behavioural difficulties

As noted above, biological processes in utero are also thought to play a role in children's physical, cognitive and psychosocial development of the child (D. J. Barker,

1998; T. C. Williams & Drake, 2015). This is more formally known as the fetal origins theory, and emphasizes the role of prenatal influences on children's development. Therefore, efforts intending to ensure optimal development in children should address factors from the perinatal as well as the postnatal period.

There is substantial research on the influence of teratogens during pregnancy, namely nicotine and alcohol. Findings have been mixed, with some studies indicating that even light exposure to alcohol is associated with increased behavioural difficulties during early childhood to early adolescence (M. Robinson et al., 2010; Sood et al., 2001), though other studies indicate that there is no such increased risk for alcohol exposure (Kelly et al., 2010; Lepper et al., 2016; Sayal et al., 2013; Skagerstróm, Chang, & Nilsen, 2011). Maternal smoking in pregnancy has been linked to externalizing behavior in children, particularly attention-deficit/hyperactivity disorder (ADHD) (Huizink & Mulder, 2006), though there is some indication that confounding factors (such as parental sociodemographics, maternal mental health and shared genes) may underlie this association (Knopik, 2009; Langley, Rice, van den Bree, & Thapar, 2005; Roza et al., 2009). Further, there is evidence that exposure to second hand smoke during pregnancy, even when accounting for concurrent smoking behavior in mothers, may adversely influence children's behavior later in life (Downey et al., 2015; Roza et al., 2009).

Conversely, maternal vitamin intake during pregnancy has been linked to beneficial outcomes in offspring during development. One of the most thoroughly researched and crucial vitamins during pregnancy is folate, or folic acid. Folate plays a key role in neurogenesis, the synthesis of neurotransmitters, and the development of the central nervous system (Roza et al., 2010). This is evidenced by the reduced risk of

neural tube defects in offspring whose mothers took folic acid supplements prior to conception and early in pregnancy (R. D. Wilson et al., 2015). Further research has found that maternal folate intake during pregnancy reduces the risk of behavioural problems during early to middle childhood (Roza et al., 2010; Schlotz et al., 2010; Steenweg–de Graaff et al., 2012). Steenweg-de Graaff et al. (2012) also found that early (i.e. periconceptional) intake of folic acid supplements was protective against behavioural difficulties in offspring aged 3 years when compared to those who did not take supplements, or whose supplement intake was later.

There is substantial evidence that maternal mental health, specifically depression and anxiety or stress, during both the antenatal and postnatal periods is linked to child behavioural development. Several review articles have supported the link between exposure to maternal antenatal stress and depression, and adverse internalizing, externalizing and cognitive outcomes later in life (Charil et al., 2010; Field, 2011; Huizink, Robles de Medina, Mulder, Visser, & Buitelaar, 2003; B. R. Van den Bergh, Mulder, Mennes, & Glover, 2005). There have been mixed findings regarding the association between postnatal depression and child behavior (Grace et al., 2003), though a meta-analysis by Beck (1998) noted that there appeared to be a small but significant effect of postnatal depression on children's emotional symptoms. In contrast, there appears to be a more consistent association between postnatal anxiety in the mother and behavioural outcomes in children (Glasheen et al., 2010), though research focusing on postnatal anxiety is limited.

Breastfeeding has also been linked to beneficial behavioural outcomes in children. Oddy et al. (2010) found that children who were breastfed for 6 months or more showed

lower internalizing, externalising and total problems scores on the Child Behaviour Checklist from early childhood through to early adolescence. Increased neurodevelopment as a result of the nutrients in breastmilk, as well as greater interaction between mother and child during breastfeeding, may underlie this association (Heikkila et al., 2011).

The studies described above identify several potential predictors of behavioural difficulties, though many do not address the influence of family processes alongside the influence of prenatal factors as well as maternal behaviour and health. However, Nau and Heckert (2013) note that integrating these perspectives in order to understand which factors may have the strongest influence on childhood behavioural difficulties is important in informing strategies that target child health and development. Furthermore, all of these studies have been conducted primarily in the United States, Europe or Australia. The current study integrates both biological and social family processes by investigating how the factors discussed above relate to serious behavioural difficulties in New Zealand (NZ) children. While it is not uncommon for studies to investigate the influences of prenatal factors alongside maternal wellbeing (Huizink et al., 2003; Jo et al., 2015; Rodriguez, 2010; Roza et al., 2010, 2009; Sayal et al., 2013), most studies have not assessed this alongside factors relating to family processes.

Using an ethnically and socioeconomically diverse sample, we sought to identify risk and protective factors of serious behavioural problems by investigating whether prenatal and postnatal maternal health and behavior, family dynamics and family support were associated with behavioural outcomes in early childhood. To our knowledge, this is the first study to assess the predictors of behavioural problems in 2-year-olds using the

Strengths and Difficulties Questionnaire (SDQ). While the SDQ is widely used in research and clinical settings, it has primarily been used to assess children aged 3 years or older (Stone et al., 2010; Youth in Mind, 2014). We have previously found that the SDQ is generally acceptable to use at age 2 (D'Souza, Waldie, Peterson, Underwood, & Morton, 2017b; D'Souza et al., 2017a).

We hypothesised that poorer maternal mental health, prenatally and postnatally, would be associated with an increased risk of behavioural problems in the child at age 2. Given the mixed findings with alcohol and nicotine exposure during pregnancy (Huizink & Mulder, 2006; Kelly et al., 2010; Knopik, 2009; Langley et al., 2005; Lepper et al., 2016; M. Robinson et al., 2010; Roza et al., 2009; Sayal et al., 2013; Skagerstróm et al., 2011; Sood et al., 2001), it is possible that there may be no significant association with children's behavioural problems at age 2. However, if significant, we hypothesised that children prenatally exposed to these teratogens were at an increased risk of showing behavioural problems than children who were not exposed. We also expected that appropriate folate exposure, greater breastfeeding duration, greater maternal parenting self-evaluation, and greater social support for the family would be protective against the development of behavioural difficulties. Finally, we hypothesised that exposure to greater physical and verbal inter-parental conflict would be associated with an increased risk of behavioural problems. However, given the large number of variables that were accounted for in our analyses, we expected that not all of these variables would be significantly associated with behavioural problems in our multivariable models. Ultimately, our results will indicate what predisposing and precipitating factors are significant predictors of

early behavioural difficulties when accounting for prenatal influences, maternal mental health, and family processes.

3.4. Methods

3.4.1. Participants

Participants were members of the longitudinal prospective *Growing Up in New Zealand* study. Details of the study's design and recruitment procedure can be found elsewhere (Morton et al., 2013; Morton, Grant, et al., 2014). In brief, the study's cohort consists of a socioeconomically and ethnically diverse sample of children, recruited via 6822 pregnant women who had expected delivery dates between 25th April 2009 and 25th March 2010. The pregnant women were from a geographical area that contains approximately one third of the NZ birth population, and covers three contiguous District Health Board regions (Morton et al., 2013). Children within the study are broadly generalizable to current NZ births (Morton et al., 2015).

Major data collection waves (DCWs) have occurred during the late antenatal period, and when the child was aged 9 months and 2 years. Computer Assisted Personal Interviews (CAPIs) were used at each face to face DCW to gather information relating to six inter-connected domains of child development: health and wellbeing; cognitive and psychosocial; family and whānau (extended family); culture and identity; and neighbourhoods and societal context. Ethical approval was granted from the Ministry of Health Northern Y Regional Ethics Committee (NTY/08/06/055), and mothers provided written informed consent for their own and their children's participation in the study.

A total of 6246 mothers (92% of the original sample) were interviewed during the 2 year DCW, when child behaviour, the outcome of interest for this particular study, was measured.

3.4.2. Measures

Child behavioural difficulties. Behavioural difficulties during early childhood were measured at age 2 using the preschool version of the Strengths and Difficulties Questionnaire (SDQ) (R. Goodman, 1997). The difficulties subscales (emotional symptoms, peer problems, hyperactivity-inattention and conduct problems) as well as the total difficulties score were of interest in the current study. We have previously found that the preschool SDQ shows acceptable psychometric properties in our cohort at age 2 (D'Souza et al., 2017a); Cronbach's alpha coefficients were found to be satisfactory for most measures (α range = 0.71-0.84), but low for peer problems (α = 0.54). However, all measures obtained satisfactory mean inter-item correlation coefficients (MIC $\geq$ 0.20) (Piedmont, 2014).

SDQ subscales range from 0 to 10, and the total difficulties score ranges from 0 to 40. These measures were categorised into normal, borderline and abnormal bands, based on previously determined cut-offs (D'Souza et al., 2017a; R. Goodman, 1997). As the current study is interested in evaluating predictors of clinically significant behavioural difficulties (i.e., the abnormal band) (R. Goodman, Ford, et al., 2000; R. Goodman, Renfrew, et al., 2000), SDQ measures were dichotomised into normal/borderline and abnormal. Children who fall within this abnormal band are generally identified as having serious behavioural difficulties, and are likely to be referred on to a specialist for further assistance (R. Goodman, Renfrew, et al., 2000; Ministry of Health, 2016).

Maternal and family predictors. Information related to perinatal and postnatal maternal health was obtained during the antenatal and 9 month DCWs respectively.

The antenatal questionnaire asked mothers about their folate or folic acid intake before pregnancy, during the first trimester, and after the first trimester. The NZ Ministry of Health recommends that women planning on becoming pregnant should take folic acid supplementation at least 4 weeks prior to becoming pregnant and during the first trimester of pregnancy, to ensure healthy development and a reduced risk of neural tube defects in the child (Stewart, 2006). Therefore, for the purpose of this study, a composite variable was created to indicate whether mothers took folate or folic acid supplements during the recommended time frame. Women were categorised as taking folic acid before and during the 1st trimester, during the 1st trimester only, and taking no folic acid. Information was also obtained on whether or not mothers took multivitamins during pregnancy.

Smoking behaviour during pregnancy (categorised as never smoked, stopped smoking, and continued smoking) as well as frequency of exposure to another smoker in the same room (no exposure vs some exposure) were also included as perinatal variables. Mothers also provided information on alcohol intake per week during the first trimester and after the first trimester, with women being dichotomised into *non-drinkers* and *1 drink or more* categories for each time period. We did not categorise drinkers into light, moderate and heavy drinking groups, as this would have resulted in low cell counts when assessed in combination with SDQ measures.

Information on maternal mental health was also obtained at both the antenatal and 9 month DCWs. Antenatal and postnatal (9 month) depression were measured using the

Edinburgh Postnatal Depression scale (EPDS) (Cox, Holden, & Sagovsky, 1987). The scale ranges from 0 to 30, with women who scored 13 or greater categorised as having clinically significant depressive symptoms (Waldie et al., 2015). Perceived maternal stress during pregnancy was measured using the Perceived Stress Scale (PSS) (S. Cohen, Kamarck, & Mermelstein, 1983). Postnatal anxiety was measured at 9 months using the Generalised Anxiety Disorder Screener (GAD-7) (Spitzer, Kroenke, Williams, & Löwe, 2006), with mothers categorised as having minimal anxiety (scores of 0 to 4), mild anxiety (scores of 5 to 9), and moderate to severe anxiety (scores of 10 to 21).

Duration of exclusive breastfeeding was obtained when the child was aged 9 months. WHO recommends that infants should be exclusively breastfed for a minimum of 6 months (World Health Organization, 2001), therefore children were categorised as either being exclusively breastfed for less than 6 months, or 6 months or more.

Measures of physical and verbal conflict within the parental relationship at 9 months were obtained using 6 items measured on a 7-point Likert scale. Both physical and verbal conflict were measured using three items each, which asked about the frequency of conflict behaviours in the past four weeks. These items have been used previously within a NZ population and have obtained good reliability coefficients (Pryor, 2004).

Maternal social support was measured at 9 months using the Family Support Scale (Dunst, Jenkins, & Trivette, 1984), which provides a measure of informal support as well as formal support. The informal support subscale indicates the extent of support that mothers feel that they receive from their family and friends, whereas the formal

support subscale measures how helpful mothers perceive formal sources of support to be (e.g. health and child-care professionals).

Finally the Evaluation subscale from the “What Being the Parent of a Baby is Like” tool (Pridham & Chang, 1989) was used to measure mothers’ evaluation of themselves as a parent at 9 months. The 11 items for the subscale assesses information such as satisfaction in being a parent and caring for an infant, perception of how well parents know the child, and the extent to which self-expectations as a parent are being met.

Control variables. A range of variables primarily relating to the family or child’s social structure were controlled for in the current study. Control variables measured at the antenatal DCW included mother’s ethnicity (European, Maori, Pacific, Asian, Other), mother’s education (no secondary school, secondary school/diploma/trade certificate, Bachelor’s degree or higher), mother’s age when pregnant (<20 years, 20-29 years, ≥30 years), child’s gender, parity (first born or subsequent birth), and whether or not the pregnancy was planned. Control variables from the 2 year DCW included whether or not the mother was in paid employment, mother’s smoking behaviour (smoker or non-smoker), area-level deprivation (high, medium, and low), and rurality (urban or rural). Children’s gestational age and birthweight were also controlled for. Descriptive information for control variables across SDQ measures are presented in the supplementary material (Tables S1 and S2).

3.4.3. Data analysis

A multiple logistic regression was conducted for each SDQ outcome. All predictor variables were included, with analyses adjusting for the aforementioned control variables.

Analyses were carried out using R version 3.3.1, and statistical significance was given at an alpha level of .05. As these potential determinants on child's behaviour occur within the context of the family's social structure, correlations between variables significant in the final model (across all SDQ subscales) and main control variables were also calculated and provided in the supplementary material (Table S3).

3.5. Results

Of the 6246 children whose mothers were interviewed at the 2 year DCW, 6242 had scores for emotional symptoms (7.2% abnormal) and conduct problems (12.4% abnormal). A total of 6241 children had hyperactivity-inattention scores (8.1% abnormal), and 6238 had scores for peer problems (9.9% abnormal). Total difficulties scores were calculated for 6233 children (10.1% abnormal). Frequency distributions for categorical predictors and descriptive information for continuous predictors across SDQ categories are presented in Tables 3.1 and 3.2, respectively. Results for the multiple logistic regressions relating to each SDQ measure are presented in Table 3.3, and have been interpreted below.

3.5.1. Determinants of emotional symptoms

The analysis revealed that a one point increase in maternal perceived stress in pregnancy was associated with a 1.04 increase in the odds of abnormal emotional symptoms in children (p <.001). Perinatal folic acid intake was also a significant predictor of early childhood emotional difficulties; the odds of having a child with abnormal emotional symptoms was 1.62 times greater for mothers who took no folic acid during the recommended time period than mothers who took folic acid when recommended (p < .05). Furthermore, the odds of having a child with emotional

symptoms was almost 2 times greater for mothers with moderate to severe postnatal anxiety relative to mothers with minimal postnatal anxiety (p <.05). All other associations were not significant. Generalised variance inflation factors (GVIF) indicated that multicollinearity between predictors was not a concern (GVIFs < 3).

3.5.2. Determinants of peer problems

Results show that the odds of having peer problems was 1.32 times greater for children who were not exclusively breastfed for a minimum of 6 months, relative to children who were exclusively breastfed for 6 months or more (p < .05). Greater informal (i.e. family/friends) support for the family was also associated with a reduced odds of the child showing peer problems (OR = 0.97, p < .05). No other associations were significant. GVIFs were satisfactory (GVIFs < 3.1).

3.5.3. Determinants of hyperactivity-inattention

As shown in Table 3.3, a one point increase in maternal perceived stress in pregnancy was associated with a 1.02 increase in the odds of abnormal hyperactivity-inattention in children (p <.05). Further, the odds of having a child with an abnormal hyperactivity-inattention score was 1.78 times greater for mothers who were exposed to another smoker in the same room during pregnancy than mothers who were not exposed (p <.05), and was almost 1.57 times greater for mothers with moderate to severe postnatal anxiety relative to mothers with minimal postnatal anxiety (p <.05). Finally, a one point increase in mother's evaluation score was associated with a reduced odds of children having abnormal hyperactivity-inattention scores (OR = 0.95, p < .001). All other associations were not significant. Multicollinearity was not of concern (GVIFs < 3).

3.5.4. Determinants of conduct problems

A one point increase in mother's perceived stress during pregnancy was associated with a 1.05 increase in the odds of an abnormal conduct problems score at age 2 (p <. 001). An increase in verbal conflict between parents at 9 months was also associated with a greater odds of an abnormal conduct problems score at 2 years (OR = 1.08, p <.001). Additionally, a one point increase in mother's evaluation score was associated with a reduced odds of children having abnormal conduct problems (OR = 0.97, p < .05). All other associations were not significant. GVIFs for predictors was acceptable (GVIFs < 3).

3.5.5. Determinants of total difficulties

Antenatal perceived stress was a significant predictor of total difficulties in early childhood, with a one point increase in perceived stress associated with a 1.06 increase in the odds of an abnormal total difficulties score (p <.001). Exclusive breastfeeding was also a significant predictor; mothers who exclusively breastfed for less than six months had a 1.35 times greater odds of having a child with an abnormal total difficulties score than mothers who exclusively breastfed for a minimum of six months (p <.05). A one point increase in verbal conflict between parents was associated with a 1.06 increase in the odds of abnormal total difficulties (p <.05). Finally, a one point increase in mother's evaluation score was associated with a reduction in the likelihood of abnormal total difficulties (OR = 0.95, p <.05). No other associations were significant, and multicollinearity between predictors was not of concern (GVIFs < 3).

Table 3.1.
Frequency distributions of SDQ subscales and total difficulties for categorical predictors.

	Emotional Symptoms		Peer Problems		Hyperactivity-Inattention		Conduct Problems		Total Difficulties	
	Normal/ Borderline n (%)	Abnormal n (%)	Normal/ Borderline n (%)	Abnormal n (%)	Normal/ Borderline n (%)	Abnormal n (%)	Normal/ Borderline n (%)	Abnormal n (%)	Normal/ Borderline n (%)	Abnormal n (%)
Antenatal depression										
Not depressed	4681 (89.0)	301 (74.9)	4547 (88.9)	432 (80.0)	4597 (88.3)	385 (85.2)	4457 (89.5)	526 (77.7)	4564 (89.4)	412 (75.2)
Depressed	576 (11.0)	101 (25.1)	568 (11.1)	108 (20.0)	610 (11.7)	67 (14.8)	525 (10.5)	151 (22.3)	539 (10.6)	136 (24.8)
Folate intake										
Pre-conception & 1st trimester	2154 (41.0)	70 (17.5)	2089 (40.9)	133 (24.7)	2073 (39.9)	150 (33.2)	2093 (42.1)	131 (19.4)	2128 (41.7)	93 (17.0)
1st trimester only	2228 (42.4)	174 (43.5)	2166 (42.4)	234 (43.4)	2197 (42.3)	206 (45.6)	2075 (41.7)	327 (48.4)	2147 (42.1)	253 (46.3)
No folate	870 (16.6)	156 (39.0)	854 (16.7)	172 (31.9)	930 (17.9)	96 (21.2)	808 (16.2)	218 (32.2)	823 (16.1)	200 (36.6)
Multivitamin intake										
Some	3271 (62.2)	173 (43.1)	3166 (61.9)	279 (51.8)	3185 (61.2)	260 (57.5)	3145 (63.2)	300 (44.4)	3217 (63.1)	226 (41.4)
None	1984 (37.8)	228 (56.9)	1947 (38.1)	260 (48.2)	2019 (38.8)	192 (42.5)	1835 (36.8)	376 (55.6)	1885 (36.9)	320 (58.6)
Prenatal smoking										
Never smoked	4273 (81.5)	264 (66.2)	4154 (81.4)	380 (70.8)	4222 (81.3)	315 (70.0)	4140 (83.3)	398 (59.1)	4198 (82.5)	334 (61.3)
Stopped smoking	484 (9.2)	62 (15.5)	479 (9.4)	67 (12.5)	484 (9.3)	62 (13.8)	438 (8.8)	108 (16.0)	459 (9.0)	86 (15.8)
Continued smoking	486 (9.3)	73 (18.3)	468 (9.2)	90 (16.8)	486 (9.4)	73 (16.2)	390 (7.9)	168 (24.9)	432 (8.5)	125 (22.9)
Exposure to another smoker										
No exposure	4935 (93.9)	339 (84.5)	4797 (93.8)	473 (87.8)	4880 (93.8)	394 (87.2)	4706 (94.5)	568 (83.9)	4813 (94.4)	453 (82.8)
Some exposure	320 (6.1)	62 (15.5)	316 (6.2)	66 (12.2)	324 (6.2)	58 (12.8)	273 (5.5)	109 (16.1)	288 (5.6)	94 (17.2)
Alcohol in 1st trimester										
Non-drinker	5012 (86.8)	370 (82.6)	4864 (86.8)	515 (83.6)	4956 (86.6)	425 (84.7)	4782 (87.6)	600 (78.5)	4873 (87.2)	501 (80.0)
1 or more drinks	764 (13.2)	78 (17.4)	740 (13.2)	101 (16.4)	765 (13.4)	77 (15.3)	678 (12.4)	164 (21.5)	716 (12.8)	125 (20.0)
Alcohol after 1st trimester										
Non-drinker	5546 (95.9)	426 (95.1)	5377 (95.8)	591 (95.9)	5492 (95.9)	479 (95.4)	5251 (96.1)	721 (94.0)	5372 (96.0)	591 (94.3)
1 or more drinks	236 (4.1)	22 (4.9)	233 (4.2)	25 (4.1)	235 (4.1)	23 (4.6)	212 (3.9)	46 (6.0)	222 (4.0)	36 (5.7)
Exclusive breastfeeding										
<6 months	4126 (75.9)	303 (77.1)	3982 (75.6)	443 (80.0)	4065 (75.8)	365 (79.5)	3867 (75.2)	561 (81.9)	3976 (75.5)	448 (81.8)
6 months or more	1307 (24.1)	90 (22.9)	1286 (24.4)	111 (20.0)	1301 (24.2)	94 (20.5)	1274 (24.8)	124 (18.1)	1293 (24.5)	100 (18.2)
Postnatal depression										
Not depressed	5251 (92.9)	344 (80.8)	5064 (92.5)	528 (88.1)	5146 (92.2)	448 (90.7)	4960 (93.0)	636 (85.5)	5089 (93.1)	499 (83.0)
Depressed	401 (7.1)	82 (19.2)	411 (7.5)	71 (11.9)	437 (7.8)	46 (9.3)	374 (7.0)	108 (14.5)	379 (6.9)	102 (17.0)
Postnatal anxiety										
Minimal anxiety	4067 (72.2)	232 (54.6)	3908 (71.6)	388 (65.0)	3975 (71.4)	324 (65.6)	3866 (72.7)	434 (58.6)	3960 (72.6)	333 (55.5)
Mild anxiety	1182 (21.0)	114 (26.8)	1156 (21.2)	140 (23.5)	1183 (21.3)	112 (22.7)	1104 (20.8)	191 (25.8)	1131 (20.7)	163 (27.2)
Moderate to severe anxiety	387 (6.9)	79 (18.6)	396 (7.3)	69 (11.6)	408 (7.3)	58 (11.7)	350 (6.6)	116 (15.7)	361 (6.6)	104 (17.3)

Table 3.2.

Descriptive information for continuous predictors across SDQ categories.

	Emotional Symptoms		Peer Problems		Hyperactivity-Inattention		Conduct Problems		Total Difficulties	
	Normal/ Borderline M (SD)	Abnormal M (SD)	Normal/ Borderline M (SD)	Abnormal M (SD)	Normal/ Borderline M (SD)	Abnormal M (SD)	Normal/ Borderline M (SD)	Abnormal M (SD)	Normal/ Borderline M (SD)	Abnormal M (SD)
Prenatal perceived stress	12.84 (6.30)	16.39 (6.63)	12.89 (6.29)	14.95 (7.02)	12.94 (6.33)	14.79 (6.77)	12.65 (6.25)	16.29 (6.46)	12.68 (6.25)	16.90 (6.41)
Physical conflict	3.35 (1.21)	4.24 (2.50)	3.37 (1.28)	3.79 (1.88)	3.40 (1.34)	3.50 (1.47)	3.34 (1.17)	4.01 (2.26)	3.34 (1.20)	4.13 (2.26)
Verbal conflict	6.20 (3.24)	7.70 (4.36)	6.24 (3.28)	6.98 (3.89)	6.23 (3.29)	7.12 (3.84)	6.06 (3.13)	8.25 (4.29)	6.12 (3.18)	8.16 (4.28)
Formal support	18.57 (4.59)	17.42 (4.75)	18.58 (4.60)	17.66 (4.61)	18.54 (4.59)	17.97 (4.85)	18.63 (4.53)	17.48 (5.04)	18.63 (4.55)	17.28 (4.92)
Informal support	21.03 (5.68)	20.57 (6.17)	21.09 (5.70)	20.14 (5.85)	21.05 (5.71)	20.42 (5.82)	21.03 (5.73)	20.71 (5.65)	21.07 (5.69)	20.32 (5.91)
Maternal evaluation	59.86 (4.55)	59.88 (4.58)	59.88 (4.58)	59.88 (4.57)	59.96 (4.55)	59.00 (4.78)	59.91 (4.57)	59.68 (4.60)	59.93 (4.53)	59.45 (4.98)

Table 3.3.
Associations between prenatal and postnatal variables and behavioural problems at 2 years, shown for each SDQ measure.

	Emotional Symptoms			Peer Problems			Hyperactivity-Inattention			Conduct Problems			Total Difficulties		
	B (SE)	OR (95% CI)	*z*	*B* (SE)	OR (95% CI)	*z*	*B* (SE)	OR (95% CI)	*z*	*B* (SE)	OR (95% CI)	*z*	*B* (SE)	OR (95% CI)	*z*
Prenatal depression															
Not depressed															
Depressed	0.07 (0.19)	1.07 (0.74, 1.53)	0.36	0.22 (0.17)	1.24 (0.88, 1.73)	1.26	-0.32 (0.20)	0.73 (0.48, 1.07)	-1.59	-0.11 (0.16)	0.90 (0.66, 1.22)	-0.66	0.03 (0.17)	1.03 (0.74, 1.42)	0.19
Prenatal perceived stress	0.04 (0.01)	1.04 (1.02, 1.07)	3.42**	0.01 (0.01)	1.01 (0.99, 1.03)	0.90	0.02 (0.01)	1.02 (1.00, 1.05)	2.18*	0.04 (0.01)	1.05 (1.03, 1.07)	4.52**	0.05 (0.01)	1.06 (1.03, 1.08)	4.90**
Folate intake															
Pre-conception & 1st trimester															
1st trimester only	0.21 (0.19)	1.24 (0.86, 1.79)	1.16	0.10 (0.14)	1.11 (0.83, 1.47)	0.71	-0.02 (0.15)	0.98 (0.74, 1.31)	-0.11	0.24 (0.14)	1.28 (0.96, 1.69)	1.70	0.09 (0.16)	1.09 (0.79, 1.51)	0.54
No folate	0.49 (0.23)	1.62 (1.04, 2.54)	2.13*	0.16 (0.19)	1.18 (0.80, 1.72)	0.84	-0.13 (0.22)	0.88 (0.57, 1.34)	-0.60	0.16 (0.19)	1.68 (0.81, 1.69)	0.83	0.08 (0.21)	1.08 (0.72, 1.62)	0.37
Multivitamin intake															
Some															
None	0.11 (0.14)	1.11 (0.84, 1.47)	0.73	-0.07 (0.12)	0.94 (0.74, 1.18)	0.58	-0.03 (0.13)	0.97 (0.75, 1.24)	-0.25	0.06 (0.11)	1.06 (0.85, 1.33)	0.52	0.15 (0.13)	1.17 (0.91, 1.50)	1.21
Prenatal smoking															
Never smoked															
Stopped smoking	0.32 (0.22)	1.38 (0.89, 2.09)	1.48	-0.04 (0.20)	0.96 (0.64, 1.41)	-0.22	0.33 (0.20)	1.39 (0.93, 2.03)	1.64	0.24 (0.17)	1.27 (0.90, 1.77)	1.36	0.04 (0.20)	1.04 (0.70, 1.52)	0.20
Continued smoking	0.34 (0.30)	1.41 (0.77, 2.53)	1.14	0.11 (0.27)	1.12 (0.65, 1.90)	0.41	0.13 (0.30)	1.14 (0.63, 2.02)	0.44	0.15 (0.23)	1.16 (0.74, 1.82)	0.67	0.001 (0.26)	1.00 (0.60, 1.66)	0.003
Exposure to another smoker															
No exposure															
Some exposure	0.17 (0.22)	1.19 (0.76, 1.83)	0.77	-0.07 (0.21)	0.93 (0.60, 1.40)	-0.34	0.58 (0.21)	1.78 (1.16, 2.70)	2.69*	0.08 (0.18)	1.08 (0.75, 1.54)	0.44	0.23 (0.19)	1.26 (0.86, 1.83)	1.21
Alcohol in 1st trimester															
Non-drinker															
1 or more drinks	0.07 (0.20)	1.07 (0.71, 1.58)	0.34	0.11 (0.17)	1.11 (0.79, 1.54)	0.64	-0.19 (0.19)	0.83 (0.57, 1.18)	-1.02	0.08 (0.15)	1.08 (0.80, 1.45)	0.53	0.07 (0.17)	1.07 (0.76, 1.50)	0.39

Table 3.3 Continued.

	Emotional Symptoms			Peer Problems			Hyperactivity-Inattention			Conduct Problems			Total Difficulties		
	B (SE)	OR (95% CI)	*z*	*B* (SE)	OR (95% CI)	*z*	*B* (SE)	OR (95% CI)	*z*	*B* (SE)	OR (95% CI)	*z*	*B* (SE)	OR (95% CI)	*z*
Alcohol after 1st trimester															
Non-drinker					0.71 (0.35, 1.31)										
1 or more drinks	-0.37 (0.40)	0.69 (0.30, 1.45)	-0.91	-0.35 (0.33)		-1.04	0.16 (0.29)	1.17 (0.64, 2.02)	0.54	-0.01 (0.27)	0.99 (0.58, 1.66)	0.98	-0.16 (0.33)	0.85 (0.43, 1.58)	-0.49
Exclusive breastfeeding															
<6 months	-0.03 (0.15)	0.97 (0.73, 1.31)	-0.20	0.27 (0.14)	1.32 (1.01, 1.73)	2.02*	0.04 (0.14)	1.05 (0.80, 1.38)	0.32	0.21 (0.13)	1.24 (0.96, 1.60)	1.64	0.30 (0.15)	1.35 (1.02, 1.82)	2.06*
6 months or more															
Postnatal depression															
Not depressed															
Depressed	0.09 (0.22)	1.09 (0.71, 1.68)	0.41	-0.19 (0.22)	0.83 (0.53, 1.27)	-0.84	-0.44 (0.25)	0.65 (0.39, 1.04)	-1.76	-0.27 (0.20)	0.77 (0.51, 1.14)	0.19	-0.11 (0.21)	0.89 (0.59, 1.34)	-0.54
Postnatal anxiety															
Minimal															
Mild	0.27 (0.16)	1.31 (0.96, 1.78)	1.69	-0.001 (0.14)	1.00 (0.76, 1.30)	-0.01	-0.01 (0.14)	0.98 (0.74, 1.30)	-0.12	-0.03 (0.13)	0.97 (0.75, 1.24)	-0.27	0.05 (0.14)	1.05 (0.79, 1.38)	0.32
Moderate to severe	0.66 (0.24)	1.93 (1.19, 3.08)	2.73*	0.10 (0.23)	1.10 (0.69, 1.73)	0.42	0.45 (0.23)	1.57 (0.99, 2.44)	1.97*	0.32 (0.21)	1.37 (0.91, 2.05)	1.52	0.29 (0.23)	1.33 (0.85, 2.05)	1.27
Physical conflict	0.06 (0.04)	1.06 (0.98, 1.14)	1.59	0.04 (0.04)	1.05 (0.97, 1.12)	1.21	-0.04 (0.05)	0.96 (0.87, 1.05)	-0.89	-0.01 (0.03)	0.99 (0.93, 1.06)	-0.22	0.02 (0.03)	1.02 (0.96, 1.10)	0.72
Verbal conflict	0.02 (0.02)	1.02 (0.98, 1.06)	0.87	0.01 (0.02)	1.01 (0.98, 1.05)	0.63	0.06 (0.02)	1.06 (1.02, 1.09)	3.03*	0.07 (0.02)	1.08 (1.05, 1.11)	4.70**	0.06 (0.02)	1.06 (1.03, 1.10)	3.43**
Formal support	-0.01 (0.01)	0.99 (0.96, 1.02)	-0.49	-0.01 (0.01)	0.99 (0.97, 1.02)	-0.53	-0.002 (0.01)	1.00 (0.97, 1.02)	-0.12	0.004 (0.01)	1.00 (0.98, 1.03)	0.34	0.01 (0.01)	1.01 (0.98, 1.03)	0.52
Informal support	-0.001 (0.01)	1.00 (0.98, 1.02)	-0.10	-0.03 (0.01)	0.97 (0.96, 0.99)	-2.52*	-0.001 (0.01)	1.00 (0.98, 1.02)	-0.12	0.01 (0.01)	1.01 (0.99, 1.03)	0.74	-0.01 (0.01)	0.99 (0.97, 1.01)	-0.91
Maternal evaluation	-0.001 (0.01)	1.00 (0.97, 1.03)	-0.05	-0.02 (0.01)	0.98 (0.96, 1.01)	-1.28	-0.05 (0.01)	0.95 (0.93, 0.97)	-4.16**	-0.03 (0.01)	0.97 (0.95, 0.99)	-2.45*	-0.05 (0.01)	0.95 (0.93, 0.98)	-3.75**

Note: ** $p < .001$, * $p < .05$.

All analyses controlled for mother's ethnicity, mother's education, mother's age when pregnant, child's gestational age, child's birthweight, child's gender, parity, planned pregnancy, mother in paid employment, area-level deprivation, and rurality.

3.6. Discussion

The current study identified antenatal and postnatal risk and protective factors, specific to the mother and family, which were associated with abnormal behavioural difficulties in 2-year-old children (i.e. in the abnormal range of the preschool SDQ total difficulties and subscales). Our results indicated that there were several prenatal and postnatal risk and protective factors associated with multiple behavioural outcomes. Perceived maternal stress during pregnancy was the only prenatal factor associated with multiple behavioural outcomes at age 2. Specifically, greater perceived maternal stress during pregnancy was associated with an increased risk of clinically significant emotional symptoms, hyperactivity-inattention, conduct problems and total difficulties. Our results also indicated that moderate to severe postnatal stress in the mother was associated with an increased risk of abnormal emotional and hyperactivity-inattention symptoms. Greater verbal conflict between parents was also associated with an increased risk of abnormal hyperactivity-inattention problems, conduct problems and total difficulties. Protective factors associated with multiple behavioural outcomes included exclusive breastfeeding and maternal parenting self-evaluation. Children who were exclusively breastfed for a minimum of 6 months were less likely to have abnormal peer problems and total difficulties, and mothers with a greater evaluation of themselves as parents when their children were 9 months were less likely to have children with abnormal hyperactivity-inattention and conduct problems, as well as total difficulties.

These findings are consistent with earlier studies investigating behavioural difficulties in children. Maternal stress during pregnancy has been associated with a multitude of adverse outcomes in offspring, impacting not just psychosocial outcomes,

but physical and cognitive development as well (Beydoun & Saftlas, 2008; Charil et al., 2010; D'Souza et al., 2016; Lamb et al., 2014; Slykerman et al., 2015). Animal studies have shown that increased levels of corticotrophin releasing hormone and cortisol in mothers as a result of stress during pregnancy have programming effects on the developing foetus, specifically with regards to the hypothalamic-pituitary-adrenal (HPA) axis and the hippocampus (Charil et al., 2010). These structures play key roles in multiple psychiatric disorders, including depression, anxiety, aggression and ADHD, therefore impaired functioning of the HPA-axis and hippocampus is thought to underlie the association between antenatal stress and behavioral development (Charil et al., 2010; Huizink et al., 2004; Weinstock, 2008). The current study adds support to this literature, and the proposed role of in utero biological processes in influencing child development, by demonstrating that greater perceived stress during pregnancy, relates to a range of behavioural outcomes from very early in development.

Our results also indicate that mothers who experience moderate to severe levels of postnatal anxiety at 9 months are more likely to have children with abnormal emotional problems and abnormal hyperactivity-inattention at age 2. Although there is considerable research investigating the effects of antenatal anxiety on child development, there is limited research evaluating how exposure to postnatal anxiety may influence child development. This is likely because most studies tend to focus on postnatal depression (Essex, Klein, Miech, & Smider, 2001; Grace et al., 2003; Verbeek et al., 2012), or do not distinguish between postnatal anxiety and depression by looking at postnatal distress in general (Amrock & Weitzman, 2014; Prady & Kiernan, 2013). Despite the lack of research, there are some studies that have supported our findings by also demonstrating

that postnatal anxiety appears to affect children's psychological development, even when controlling for antenatal anxiety and postnatal depression (Glasheen et al., 2010).

The finding that exclusive breastfeeding for a minimum of 6 months was protective against the development of age 2 behavioural problems (specifically peer problems and total difficulties) is consistent with that of Heikkila et al. (2011) and Oddy et al. (2010). Animal studies have indicated that the hormone leptin in breastmilk may have a positive effect on the development of the stress response, as it appears to influence the function of the hippocampus, hypothalamus, and pituitary and adrenal glands (Walker et al., 2004); thus a longer exclusive breastfeeding duration may result in a more adaptive stress response in children. There may also be a psychological mechanism underlying this association; endocrine and sensory factors associated with breastfeeding may lead to greater sensitivity and attachment between mother and child (Jansen, de Weerth, & Riksen-Walraven, 2008), which can be protective against the development of behavioural difficulties (Moss, Rousseau, Parent, St-Laurent, & Saintonge, 1998; Niccols & Feldman, 2006; Stams, Juffer, & van IJzendoorn, 2002). This latter, somewhat social mechanism may be particularly relevant for the association between greater exclusive breastfeeding and reduced peer problems, as increased sensitivity in the child may foster more positive social behaviours towards peers.

The finding that high maternal self-evaluation at 9 months, which encompasses maternal self-efficacy, satisfaction and knowledge, is protective against developing several behavioural difficulties at 2 years is not surprising, as there is evidence to indicate that these factors are related to greater child adjustment (Coleman & Karraker, 2003; Johnston & Mash, 1989; Jones & Prinz, 2005). It has been suggested that mothers with

high self-evaluations are more mentally and emotionally available to respond and attend to their children's needs, and show greater persistence in parenting, which in turn results in greater adjustment and more beneficial developmental outcomes in their children (Coleman & Karraker, 2003; Grusec, Hastings, & Mammone, 1994; Pridham & Chang, 1992). Mothers with low self-evaluations also tend to show poorer mental health (Coleman & Karraker, 2003; Cutrona & Troutman, 1986). As such, enabling mothers to develop greater self-evaluations is important for both maternal and child wellbeing.

We found that verbal, but not physical, conflict between parents during the postnatal period was predictive of later hyperactivity-inattention problems, conduct problems and total difficulties. Several studies have shown that inter-parental aggression can affect child adjustment, with externalizing behaviours being the most common outcome (Carlson, 2000). The reason that inter-parental physical conflict was not a significant predictor of behavioural difficulties in our study may be due to differences in children's exposure to the different types of conflict. Studies have shown that the child being present during the conflict is particularly important in determining whether or not the child shows poor adjustment (Carlson, 2000; Pendry, Carr, Papp, & Antles, 2013). It is possible that children are more exposed to verbal conflict between parents rather than physical conflict, and it is fair to assume that verbal conflict is more common than physical conflict in relationships. Indeed, prevalence estimates for intimate partner violence are greater when also accounting for verbal abuse, rather than just physical abuse (Carlson, 2000). We do not have information on whether or not children were present during inter-parental conflict, however we encourage future studies to investigate

whether frequent exposure to verbal conflict between parents is more harmful to children's development than rare exposure to physical conflict.

Mothers' folate intake before and during pregnancy was the only factor associated specifically with abnormal emotional symptoms in children at age 2. Children whose mothers began their folic acid intake before pregnancy were less likely to develop emotional problems than children whose mothers did not take any folic acid while pregnant. Though the exact mechanism underlying this association is yet to be fully determined, lack of adequate folic acid intake may have programming effects on neuronal development and the synthesis of catecholamines and serotonin (Craciunescu et al., 2004; Roza et al., 2010; Xiao et al., 2005). Further, the current hypothesis regarding how the foetal environment impacts later development is through epigenetic processes such as DNA methylation (Burdge & Lillycrop, 2010), which folate appears to play a role in (Nafee, Farrell, Carroll, Fryer, & Ismail, 2008; Roza et al., 2010; Wolff, Kodell, Moore, & Cooney, 1998).

The only factor significantly relating to peer problems in 2 year old children was social support from informal sources, i.e. friends and family. Our results indicate that children whose families had greater support from family and friends were less likely to have children with abnormal peer problems. Having greater social support from friends and family may mean that the child is exposed to greater social interactions, which may promote more positive social behaviour in the child, and consequently reduced problems with peers. However, it is important to note that previous research with our cohort has found that the peer problems subscale was the only SDQ measure that showed a less than

satisfactory Cronbach's alpha (D'Souza et al., 2017a); as such, these results should be interpreted with caution.

Antenatal exposure to another smoker in the same room was the only risk factor specific to abnormal hyperactivity-inattention problems at age 2 years. Review articles by Williams and Ross (2007) and Herrmann, King and Weitzman (2008) have both noted that antenatal exposure to nicotine is associated with greater hyperactivity, inattention, and an increased likelihood of ADHD diagnoses. However, it is interesting that our analyses found that antenatal exposure to another smoker rather that antenatal nicotine exposure from the mother was a significant predictor of abnormal hyperactivity-inattention problems. Similar results have also been obtained by Downey et al. (2015), who found that maternal second hand smoke exposure, but not active smoking behavior, was associated with attention problems in 2 year olds. While further research is needed to understand this association, these findings highlight the importance of minimizing second hand smoke exposure in pregnant women.

Overall, the findings seem to indicate that both intrauterine biological processes and family processes influence child behavior, though the specific factors may differ depending on the outcome measured. It is also important to acknowledge that these risk and protective factors occur within the context of a family's social structure; as such, intervention strategies focusing on these factors must also consider how they may relate to a family's socioeconomic and demographic standing. Correlations between significant determinants identified in the current study and sociodemographic control variables were primarily small in size (see supplementary material; Table S3); however, there were some moderate to large correlations that should be mentioned. Specifically, not taking folate

during the recommended time frame, and being exposed to second hand smoke were both associated with mothers who were less educated, younger, did not have a planned pregnancy, and whose families were from a more deprived area. Not taking folate appropriately was also associated with mothers who identified as non-European. Future research should investigate potential moderating or mediating effects to further understand these associations, and how they may relate to the development of behavioural problems.

We should also acknowledge that abnormal behavioural difficulties may also occur as a result of an accumulation of several of the risk factors addressed in the current study, as there is evidence that a greater number of risk factors in childhood are associated with poorer behavioural outcomes (Appleyard, Egeland, van Dulmen, & Alan Sroufe, 2005; S. Williams, Anderson, Mcgee, & Silva, 1990). Currently, *Growing Up in New Zealand* is also investigating whether a measure of cumulative risk relates to abnormal behavioural difficulties in children.

There are some limitations with the current study. Firstly, as perinatal data was gathered from mothers during late pregnancy, we cannot exclude the possibility of recall bias for information pertaining to pre-pregnancy or early pregnancy (e.g. folate and multivitamin intake, alcohol use). Further, the SDQ is used as a screening tool rather than a diagnostic instrument, and we have yet to validate the measure against formal clinical diagnoses. However, this is made more difficult by the fact that very few children within the cohort have been diagnosed with any psychosocial disorder at age 2. Nevertheless, we aim to evaluate the SDQ against clinical diagnoses as more of this information becomes available in future *Growing Up in New Zealand* DCWs.

It is important to note that we may not have found significant associations between alcohol exposure in pregnancy and abnormal child behavior due to our categorisation of maternal alcohol consumption. We compared non-drinkers to drinkers, with drinkers including all those who consumed at least one drink a week. The disadvantage of this is that we are not separately evaluating the impact of light, moderate and heavy drinking on child behaviour. There is some evidence that even light drinking contributes to behavioural difficulties (M. Robinson et al., 2010; Sood et al., 2001), however other studies suggest that there is a dose-response effect associated with prenatal alcohol exposure (Olson et al., 1997; Sood et al., 2001). Unfortunately, while we did ask mothers how much they drank per week during and after the first trimester, we were unable to separately evaluate the potential influences of light, moderate, and heavy drinking due to few mothers consuming moderate to higher levels of alcohol, particularly when evaluating alcohol consumption after the first trimester.

There are several strengths to the current study. Primarily, the use of a large, diverse, population-based sample with high participation rates means that the results are broadly generalizable to the NZ population. The multidisciplinary nature of the *Growing Up in New Zealand* study also allows us to evaluate the potential influence of a broad range of variables, including maternal health and wellbeing, and family dynamics, while also effectively controlling for several sociodemographic factors. To our knowledge, this is also the first study to evaluate predictors of abnormal SDQ scores at age 2.

Previous research has shown that behavioural and emotional problems in early childhood can increase the risk of later adverse health and wellbeing outcomes. Therefore, identifying risk or protective factors for early behavioral difficulties may help

inform the development of prevention and intervention strategies for individuals within the population. The current study identified several antenatal and postnatal maternal health factors as well as factors relating to inter-parental dynamics that increased children's risk of displaying abnormal behavioural difficulties. As children within the *Growing Up in New Zealand* cohort continue to develop, future studies will investigate whether these variables predict ongoing behavioural difficulties, as well as identifying factors that may lead to a reduction in problem behaviours.

Overall, our results ultimately suggest that maternal prenatal and postnatal wellbeing is particularly important for children's behavioural development. Specifically, pregnant women should not only be educated by their general practitioner on the importance of engaging in health-related behaviours that may positively impact that their child's development, but also minimizing their experiences of stress. Pregnant women may benefit from being informed on specific techniques that may help reduce any prenatal stress, such as practicing mindfulness or prenatal yoga (Beddoe, Paul Yang, Kennedy, Weiss, & Lee, 2009; Vieten & Astin, 2008). Further, postnatal checkups with the mother and child should also enquire about the mother's wellbeing and their evaluation of themselves as a parent. Women who are experiencing postnatal anxiety or may have a low maternal evaluation of themselves would likely benefit from being referred on to appropriate support services, such as the Plunket organization in New Zealand ("Plunket," n.d.).

3.7. Summary

Behavioural difficulties during childhood have significant implications for mental and physical health outcomes later in life. The identification of risk and protective factors

associated with such behavioural difficulties are vital for guiding intervention and prevention efforts. Our study is particularly important because few studies have assessed behavioural problems in children as young as 2 years of age. We assessed whether antenatal and postnatal maternal health, postnatal family dynamics/support and mothers' parental self-evaluation were associated with SDQ behavioural difficulties at age 2 years in 6246 New Zealand children and their mothers from a longitudinal, population-based birth cohort. 10.1% of 2 year old cohort children had total difficulties scores on the abnormal range. Risk factors for children's emotional problems were: antenatal maternal perceived stress; lack of periconceptional folate supplements; moderate to severe maternal postnatal anxiety. Risk factors for abnormal hyperactivity-inattention were: antenatal maternal perceived stress; mothers' antenatal exposure to second hand smoke; moderate to severe maternal postnatal anxiety; low maternal self-evaluation. Risk factors for conduct problems and total difficulties were: antenatal maternal perceived stress; verbal inter-parental conflict; low maternal self-evaluation. Exclusive breastfeeding for less than 6 months, as opposed to a longer duration, was also a risk factor for total difficulties in the abnormal range in 2 year olds. The current study identified several antenatal and postnatal maternal health factors and behaviours, as well as factors relating to inter-parental dynamics, which increased the odds of behavioural difficulties being in the abnormal range in early childhood.

4. Persistence and change in behavioural problems during early childhood (Study 4)

4.1. Chapter prologue

Once data from the 4.5 year DCW was cleaned and made available by *Growing Up in New Zealand*, we investigated the stability in SDQ-measured behavioural difficulties from 2 to 4.5 years (i.e. addressed the third research question). However, prior to evaluating this, we were made aware that there was no data available for an item corresponding to the conduct problems subscale ('often fights with other children or bullies them'), as this was accidentally removed from the final questionnaire used in field. The SDQ used in the 4.5 year DCW (i.e. the SDQ omitting the missing item) is provided in Appendix C.

Several methods were investigated to determine how to address the missing item, specifically single imputation, multiple imputation, and pro-rating across subscale items (this latter method is the standard method for scoring the SDQ, as it still allows scores to be calculated if one or two subscale items are missing; Youth in Mind, 2014). Following consultation with members of the *Growing Up in New Zealand* team (notably Drs Lisa Underwood and Jin Russell), it was determined that neither imputation method would be appropriate, as both rely on having some observed values for the item being imputed. Dr Lisa Underwood also investigated the possibility of imputing the scores for the corresponding item at age 2. However, the distribution in item responses differed across age, with more children obtaining the *not true* response at age 4.5 years than at 2 years (see Table C1 in Appendix C).

Finally, to evaluate whether using pro-rated SDQ scores would be appropriate, the missing item was removed from the 2 year SDQ data, and the items for the conduct problems subscale were pro-rated to account for the removed item. The resulting subscale and total difficulties scores were then compared to the conduct problems and total difficulties scores incorporating all items. Significant differences were observed in mean scores and the categorisation of conduct problems and total difficulties (see Table C2 in Appendix C), though both measures were still strongly correlated (*rs* > .98).

It was decided that, for the purposes of Study 4, the latter pro-rating method would be used to account for the missing item, as it seemed most appropriate and parsimonious. Prior to continuing with calculating subscale and total difficulties scores, we also evaluated the psychometric properties of the 4.5 year SDQ using the same methods detailed in Section 2A.3.3 (i.e. confirmatory factor analyses, comparing both the original and modified five-factor models). Standardised factor loadings for the original and modified models are displayed in Table C3 of Appendix C. Consistent with the results from Studies 1 and 2, superior model fit was observed with the modified five-factor model ($\chi^2_{(237)}$ = 3164.34; CFI = .926; TLI = .914; RMSEA = .046) relative to the original model ($\chi^2_{(242)}$ = 7185.45; CFI = .825; TLI = .800; RMSEA = .069). However, we found poor Cronbach's alpha coefficients for both peer (α = .55) and conduct problems (α = .47). As estimates of Cronbach's alpha can be affected by the number of scale items (Nunnally & Bernstein, 1994; Streiner, 2003), it is possible that this low alpha for conduct problems is due to the reduced number of items. Cronbach's alpha coefficients for all 4.5 year SDQ measures can be found in the notes section of Table C3.

Following these preliminary analyses, we categorised age 4.5 year SDQ scores into normal/borderline and abnormal, and then calculated the persistence and change in serious behavioural problems from 2 to 4.5 years. We also evaluated the association between preschool behavioural stability (using total difficulties) and sociodemographic factors. A copy of Study 4 is currently under review at *BMC Pediatrics.*

4.2. Abstract

Background: Developmental health initiatives often target the preschool period for the prevention of later adverse outcomes. However there is evidence that behavioural difficulties may not be stable over this period. Therefore, the current study was interested in evaluating the persistence and change in clinically relevant behavioural problems during early childhood in a population-based New Zealand birth cohort.

Methods: Behaviour was assessed in 5896 children when they were aged 2 and 4.5 years using the Strengths and Difficulties Questionnaire (SDQ). Subscale and total difficulties scores were dichotomised into normal/borderline and abnormal ranges to evaluate the persistence and change in significant behavioural problems. Chi-square analyses and ANOVAs were used to determine the association between sociodemographic and birth variables, and preschool behavioural stability.

Results: Raw scores at ages 2 and 4.5 years were moderately correlated, with most measures showing a small but significant decrease in mean scores over time. The majority of children who showed abnormal behaviour at 2 years improved at 4.5 years (57.9% for total difficulties). However, a notable proportion persisted in their difficulties from 2 to 4.5 years (42.1% for total difficulties). There was a small percentage of children who were categorised as abnormal only at 4.5 years. Children with difficulties at

one or both time points had a greater proportion who were male, were the result of an unplanned pregnancy, lived in highly deprived urban areas, and had mothers who were younger, of Māori and Pacific ethnicity and were less educated.

Conclusions: Not all children who show early behavioural difficulties persist in these difficulties. Those whose difficulties persist were more likely to experience risk factors for vulnerability relative to children with no difficulties. Repeated screening for early childhood behavioural difficulties is important.

4.3. Introduction

Several studies argue for the early intervention of behavioural problems, as behavioural difficulties identified in children can persist and increase a child's risk of later adverse outcomes. For example, children who show behavioural problems during childhood are at an increased risk of ongoing mental health difficulties (Fergusson et al., 2005; Fergusson, Lynskey, & Horwood, 1996; Jakobsen, Horwood, et al., 2012; Mistry et al., 2017; Odgers et al., 2007), a greater physical health burden (Odgers et al., 2007), relationship and parenting problems (Fergusson et al., 2005; Raudino, Woodward, Fergusson, & Horwood, 2012), poor academic outcomes (McGee et al., 2002), criminal behaviour (Fergusson et al., 2005; Jakobsen, Fergusson, & Horwood, 2012), substance abuse (Fergusson et al., 2005; Hayatbakhsh et al., 2008), as well as teen pregnancy and sexual risk-taking (Fergusson et al., 2005; Ramrakha et al., 2007). These studies typically focus their initial assessments on children around school age or older. However, it has recently been demonstrated that difficulties that persist throughout childhood can be measured in children as young as 18 months of age (Mathiesen & Sanson, 2000).

The studies mentioned above illustrate a shift from viewing clinically significant behavioural problems as distinct episodes, to instead considering them as recurrent or persistent issues. There is, however, a dearth of research evaluating the persistence or change in clinically significant behavioural problems during early childhood specifically, as the majority of studies have used continuous measures to assess behavioural stability (Côté et al., 2009; Galéra et al., 2011; Mathiesen, Sanson, Stoolmiller, & Karevold, 2009). To date, we are only aware of one study that has evaluated the persistence and change in behavioural problems in early childhood using categorical measures. Mathieson and Sanson evaluated social, internalising and externalising behavioural problems in a Norwegian community sample when children were 18 months and 30 months (Mathiesen & Sanson, 2000). As most children scored closed to the norm when behaviours were evaluated continuously, children were categorised as showing either problematic or non-problematic behaviour at the two time points. While 2.5%-3.9% of the overall sample showed persistence in behavioural problems, the authors found that approximately 37% of children with problems at 18 months persisted in their difficulties at 30 months. This indicates that a substantial proportion of children initially identified as showing difficulties may improve over the early childhood period.

It is arguably more important to understand whether clinically significant behavioural difficulties remain stable during early childhood, given the focus on targeting the preschool period for the prevention of further difficulties later in life (Nelson et al., 2003). For example, the New Zealand Ministry of Health provides a free health and development check to preschool children known as the B4 School check, which includes an assessment on children's social and emotional wellbeing (Ministry of Health, 2015a).

The aim of the check is to identify any difficulties the child may have, so that their needs are met and they are given the opportunity for optimal development. It is also important to explore the characteristics of children who show different behavioural development profiles, as this will indicate whether certain sociodemographic populations are more at risk of persistent behavioural problems.

The *Growing Up* in *New Zealand* study is a longitudinal, prospective study consisting of a large population-based birth cohort. The study assessed child behaviour using the Strengths and Difficulties Questionnaire (SDQ) when children in the cohort were aged 2 and 4.5 years. The assessment of behavioural difficulties at age 2 was a unique feature of this study, as this was the first time the SDQ was administered and validated in a sample as young as 2 years (D'Souza et al., 2017a). Further, most large population-based studies of this nature, both within New Zealand or internationally, have typically assessed internalising and externalising behaviour as well as total difficulties at a single time point during the preschool period, and have therefore not provided information on whether behavioural problems are stable during this time. Therefore, the aim of the current project was to calculate the rates of persistence or change in the categorisation of behavioural difficulties during this early childhood period (i.e. 2 to 4.5 years), as well as evaluate the sociodemographic characteristics of each of the apparent behavioural development profiles.

4.4. Methods

4.4.1. Design and Participants

Participants were members of the *Growing Up in New Zealand* study. Details of the study's design and recruitment procedure can be found elsewhere (Morton et al.,

2013; Morton, Grant, et al., 2014). In brief, the study's cohort consists of a socioeconomically and ethnically diverse sample of children, recruited via 6822 pregnant women who had expected delivery dates between 25th April 2009 and 25th March 2010. Pregnant women were recruited from a geographical area that contains approximately one third of the NZ birth population, and covers three contiguous District Health Board regions (Morton et al., 2013). Children in the study are broadly generalizable to current NZ births (Morton et al., 2013).

Major data collection waves (DCWs) have occurred during late pregnancy, and when children were aged 9 months, 2 years, and 4.5 years. Information gathered at each DCW relate to six inter-connected domains of child development: health and wellbeing; cognitive and psychosocial; education; family and whānau (extended family); culture and identity; and neighbourhoods and societal context.

Children were included in the analyses only if their behaviour was measured at both ages 2 and 4.5 years. There were 348 children lost to follow up from the 2 year DCW to the 4.5 year DCW; however, 171 children who were not assessed at 2 years were followed up at 4.5 years. Children lost to follow up from age 2 to 4.5 years were more likely to have mothers who were younger, less educated and non-European, more likely to be part of an unplanned pregnancy, more likely to come from highly deprived areas at the 2 year DCW, and less likely to live in rural regions at age 2 ($ps < .05$). Further, children lost to follow up were also more likely to be categorised as abnormal on all SDQ scores at age 2 ($ps < .05$). The final sample consisted of 5896 children.

4.4.2. Measures

Strengths and Difficulties Questionnaire. Behavioural difficulties were measured at 2 and 4.5 years using the mother-reported SDQ (R. Goodman, 1997). At 2 years, the preschool SDQ was used, while at 4.5 years the standard SDQ was administered. Details of the minor differences between the preschool and standard SDQ can be found on the SDQ website (Youth in Mind, 2014). An item (‘often fights with other children or bullies them’) corresponding to the conduct problems subscale was missing from the 4.5-year questionnaire (due to an administrative error); therefore, the subscale score was prorated to account for this missing item. The current study focuses on the difficulties subscales (emotional symptoms, peer problems, hyperactivity-inattention and conduct problems) as well as the total difficulties score.

SDQ subscales range from 0 to 10, and total difficulties ranges from 0 to 40. These scores were also categorised into normal, borderline and abnormal bands based on previously determined cut-offs (D’Souza et al., 2017a; R. Goodman, 1997). The abnormal band is typically used to identify children in need of further assessment and intervention (R. Goodman, Ford, et al., 2000; R. Goodman, Renfrew, et al., 2000). SDQ measures were dichotomised into normal/borderline and abnormal in the current study, as we were primarily interested in movement into and out of the clinically significant abnormal range.

Sociodemographic and birth variables. Variables relating to the child or family’s social structure included mother’s ethnicity, mother’s education, mother’s age, child’s gender, parity, planned pregnancy, area-level deprivation, and rurality. Birthweight and gestational age were also of interest in the current study. Information on

all variables except area-level deprivation and rurality were collected during the antenatal data collection wave. Information on area-level deprivation and rurality were collected during the 4.5 year DCW.

Mother's self-prioritised ethnicity was categorised into four Level 1 Statistics New Zealand categories: European, Māori, Pacific, and Asian/Other (Statistics New Zealand, 2005). If a self-prioritised ethnicity was not provided, external prioritisation was used in cases of mothers with multiple ethnic identifications (as utilised by Statistics New Zealand, (2004).

Mother's highest education was categorised into the following three levels: No secondary school; Secondary school/diploma/trade certificate; Bachelor's degree or higher. Mother's age during pregnancy was categorised as less than 20 years, 20-29 years, and 30 years and over.

Area-level deprivation was measured using the NZDep2013, based on indicators of socioeconomic deprivation from the 2013 NZ census. Deprivation areas received a deprivation score from 1 (least deprived) to 10 (most deprived). Deprivation was categorised into high (deciles 8-10), medium (deciles 4-7), and low (deciles 1-3) deprivation.

4.4.3. Data analysis

Correlations between SDQ measures at 2 and 4.5 years were calculated using Pearson correlation coefficients. Mean differences in SDQ scores were investigated using paired sample *t*-tests, with effect sizes calculated using Cohen's *d* (J. Cohen, 1988). A contingency table was used to demonstrate the persistence and change in SDQ categorisation from 2 to 4.5 years.

A composite measure of behavioural stability was also created using the 2 year and 4.5 year SDQ total difficulties scores. Children were categorised as showing no difficulties (normal/borderline scores at 2 and 4.5 years), improved (abnormal score at 2 years only), later difficulties (abnormal score at 4.5 years only), and persistent difficulties (abnormal scores at 2 and 4.5 years). Chi-square analyses were used to evaluate the association between sociodemographic variables and behavioural stability, and to determine sociodemographic characteristics for each group. For continuous birth variables (i.e. birthweight, gestational age), ANOVAs were conducted.

4.5. Results

4.5.1. Correlation and differences in SDQ scores from 2 to 4.5 years

The correlation between SDQ measures at 2 and 4.5 years are presented in Table 4.1, as well as the t-value and effect size from the paired t-test comparing the mean scores at the two time points.

Significant moderate correlations were found for all SDQ measures, Pearson $r > 0.30$, *ps* $<.001$. There were also significant differences in scores for all SDQ measures from 2 to 4.5 years, *ps* $<.001$. On average, all scores decreased from 2 to 4.5 years, except for emotional symptoms, which showed a negligible increase.

4.5.2. SDQ categorisations at 2 and 4.5 years

Table 4.1 also presents the normal/borderline and abnormal frequencies for each SDQ measure at ages 2 and 4.5 years. At age 2, 6.7% of children had abnormal scores for emotional symptoms, 9.5% had abnormal scores for peer problems, 7.9% had abnormal hyperactivity-inattention scores, and 12.2% had abnormal conduct problems. Abnormal total difficulties scores were observed for 9.5% of the cohort.

Table 4.1.
Frequency distributions of behavioural categorisations, descriptive statistics, paired sample t-test results and correlations between age 2 and 4.5 year SDQ scores.

	2 years			4.5 years					
	Normal/ Borderline n (%)	Abnormal n (%)	M (SD)	Normal/ Borderline n (%)	Abnormal n (%)	M (SD)	t	Cohen's *d*	Pearson *r*
Emotional symptoms	5497 (93.3%)	397 (6.7%)	1.80 (1.60)	5321 (90.3%)	573 (9.7%)	1.98 (1.77)	-6.71**	-0.1	0.43**
Peer problems	5330 (90.5%)	561 (9.5%)	2.17 (1.66)	5116 (86.8%)	775 (13.2%)	1.61 (1.60)	24.53**	0.31	0.37**
Hyperactivity-inattention	5428 (92.1%)	465 (7.9%)	4.32 (2.14)	5123 (86.9%)	770 (13.1%)	3.92 (2.26)	13.98**	0.17	0.45**
Conduct problems	5177 (87.8%)	716 (12.2%)	3.11 (1.97)	5237 (88.9%)	656 (11.1%)	2.35 (1.82)	27.57**	0.36	0.37**
Total difficulties	5327 (90.5%)	558 (9.5%)	11.40 (5.11)	5222 (88.7%)	663 (11.3%)	9.86 (5.19)	25.15**	0.31	0.54**

Note: ** $p < .001$

Table 4.2.
Contingency table of 2 year and 4.5 year behavioural categorisations for each SDQ measure.

		4.5 years									
		Emotional symptoms		Peer problems		Hyperactivity-Inattention		Conduct problems		Total difficulties	
		Normal/ Borderline n (%)	Abnormal n (%)	Normal/ Borderline n (%)	Abnormal n (%)	Normal/ Borderline n (%)	Abnormal n (%)	Normal/ Borderline n (%)	Abnormal n (%)	Normal/ Borderline n (%)	Abnormal n (%)
2 years	Normal/ Borderline	5078 (92.40%)	419 (7.6%)	4748 (89.10%)	582 (10.90%)	4834 (89.10%)	594 (10.90%)	4718 (91.10%)	459 (8.90%)	4899 (92.00%)	428 (8.00%)
	Abnormal	243 (61.20%)	154 (38.8%)	368 (65.60%)	193 (34.40%)	289 (62.20%)	176 (37.80%)	519 (72.50%)	197 (27.50%)	323 (57.90%)	235 (42.10%)

At 4.5 years, 9.7% of children had abnormal emotional symptoms, approximately 13% had abnormal scores for peer problems and hyperactivity-inattention, and 11.1% had abnormal conduct problems. Total difficulties were in the abnormal range for 11.3% of children.

4.5.3. Persistence and change in behaviour from 2 to 4.5 years

Table 4.2 presents the frequency distribution of behavioural categorisations for all SDQ measures cross-tabulated across ages 2 and 4.5 years. Of those who scored in the normal/borderline range at 2 years, approximately 90% remained in this range at 4.5 years (92.4% emotional symptoms; 89.1% peer problems; 89.1% hyperactivity-inattention; 91.1% conduct problems; 92%% total difficulties). A small percentage of children who scored in the normal/borderline range at 2 years showed an increase into the abnormal range at 4.5 years (7.6% emotional symptoms; 10.9% peer problems; 10.9% hyperactivity-inattention; 8.9% conduct problems; 8% total difficulties).

For children that scored in the abnormal range at 2 years, approximately 60%-70% of children improved to score in the normal/borderline range for most SDQ measures (61.2% emotional symptoms; 65.6% peer problems; 62.2% hyperactivity-inattention; 72.5% conduct problems; 57.9% total difficulties).

A notable percentage of children who scored in the abnormal range at 2 years showed persistence in abnormal scores at 4.5 years (38.8% emotional symptoms; 34.4% peer problems; 37.8% hyperactivity-inattention; 27.5% conduct problems; 42.1% total difficulties).

When looking at the overall cohort, approximately 80% of children remained in the normal/borderline range from 2 to 4.5 years – i.e. showed no difficulties (86.2%

emotional symptoms; 80.6% peer problems; 82% hyperactivity-inattention; 80.1% conduct problems; 83.2% total difficulties); 4%-8% of the total cohort improved from abnormal at 2 years to normal/borderline at 4.5 years (4.1% emotional symptoms; 6.2% peer problems; 4.9% hyperactivity-inattention; 8.8% conduct problems; 5.5% total difficulties); 7%-10% only showed abnormal scores at 4.5 years – i.e. later difficulties (7.1% for emotional symptoms, 9.9% for peer problems; 10.1% for hyperactivity-inattention; 7.9% in conduct problems; 7.3% total difficulties); and approximately 3% of the overall cohort showed persistence in abnormal scores from 2 to 4.5 years (2.6% emotional symptoms; 3.3% peer problems; 3% hyperactivity-inattention; 3.3% conduct problems; 4% total difficulties).

4.5.4. Association between behavioural stability, and sociodemographic and birth variables.

Refer to Table 4.3 for results from the chi-square tests and for proportions discussed below. All sociodemographic variables were significantly associated with SDQ stability (*ps* <.05), except parity. Within the groups that showed behavioural difficulties during at least one time point (i.e. improved, later difficulties, and persistent difficulties), there was a greater proportion of children born to Māori or Pacific mothers relative to children showing no difficulties. Children with persistent difficulties had the greatest proportion of Māori and Pacific mothers.

Relative to children with no difficulties, those who showed difficulties during at least one time point also had a greater proportion of mothers with no secondary school education, and fewer mothers who had achieved a Bachelor’s degree or higher.

Table 4.3.
Association between behavioural stability profiles, and sociodemographic and birth variables.

	No difficulties n (%) or M (SD)	Improved n (%) or M (SD)	Later difficulties n (%) or M (SD)	Persistent difficulties n (%) or M (SD)	X2 or F-value
Mother's ethnicity					
European	3055 (63.2)	99 (31.3)	148 (35.5)	44 (19.1)	586.5**
Maori	540 (11.2)	74 (23.4)	78 (18.7)	66 (28.7)	
Pacific	426 (8.8)	79 (25.0)	117 (28.1)	95 (41.3)	
Asian/Other	810 (16.8)	64 (20.3)	74 (17.7)	25 (10.9)	
Mother's education					
No secondary school	214 (4.4)	36 (11.4)	53 (12.8)	44 (19.2)	356.90**
Secondary school/diploma/trade certificate	2399 (49.6)	222 (70.5)	282 (68.3)	157 (68.6)	
Bachelor's degree or higher	2227 (46.0)	57 (18.1)	78 (18.9)	28 (12.2)	
Mother's age					
<20 years	139 (2.9)	28 (8.8)	35 (8.4)	31 (13.4)	291.21**
20 to 29 years	1652 (34.1)	167 (52.7)	220 (52.5)	134 (58.0)	
30 years and over	3053 (63.0)	122 (38.5)	164 (39.1)	66 (28.6)	
Child's gender					
Male	2481 (50.6)	176 (54.5)	249 (58.2)	136 (57.9)	13.97*
Female	2418 (49.4)	147 (45.5)	179 (41.8)	99 (42.1)	
Parity					
First born	2056 (42.5)	133 (42.1)	183 (43.9)	87 (37.8)	2.37
Subsequent birth	2785 (57.5)	183 (57.9)	234 (56.1)	143 (62.2)	
Planned pregnancy					
Yes	3207 (66.5)	140 (44.4)	191 (46.0)	80 (34.9)	198.37**
No	1619 (33.5)	175 (55.6)	224 (54.0)	149 (65.1)	
Area-level deprivation					
Low	1603 (34.4)	56 (18.5)	63 (15.3)	16 (7.2)	389.48**
Medium	1778 (38.2)	91 (30.1)	108 (26.2)	49 (22.2)	
High	1277 (27.4)	155 (51.3)	241 (58.5)	156 (70.6)	
Rurality					
Urban	4181 (89.8)	284 (94.0)	380 (92.2)	215 (97.3)	20.58**
Rural	477 (10.2)	18 (6.0)	32 (7.8)	6 (2.7)	
Gestational age in weeks	39.20 (1.71)	39.15 (1.67)	39.06 (1.67)	39.27 (1.42)	1.11
Birthweight in grams	3526.35 (553.65)	3497.95 (553.78)	3459.73 (540.71)	3510.15 (545.86)	2.07

Note: ***p* <.001, **p* <.05.
Behavioural stability profiles were based on SDQ total difficulties categorisations at 2 and 4.5 years.

Children with no difficulties had the greatest proportion of mothers aged 30 years or over. In contrast, children who showed difficulties during at least one time point had a greater proportion of teen mothers relative to children showing no difficulties, with the persistent difficulties group showing the greatest proportion.

Relative to children showing no difficulties, the other groups had a greater percentage of males (particularly those with later or persistent difficulties) and a greater percentage of children born from unplanned pregnancies (particularly those with persistent difficulties).

Children within any of the groups showing difficulties during at least one time point had a notably greater percentage of children living in highly deprived areas, relative to those with no difficulties. Children with persistent difficulties in particular had the greatest proportion living in high deprivation areas relative to other groups. Those with persistent difficulties also had a greater proportion of children living in urban areas relative to children with no difficulties.

The results from the ANOVAs showed that there was no significant difference between behavioural stability groups in either birthweight or gestational age (Table 4.3, *ps* > .05).

4.6. Discussion

The current study evaluated the persistence and change in categorisations of behavioural difficulties during early childhood. We also compared continuous SDQ subscale and total scores at 2 and 4.5 years. Importantly, SDQ scores at 2 and 4.5 years were only moderately correlated, with all scores except emotional symptoms showing a slight but significant decrease as the children got older.

With regard to SDQ categorisations, approximately 90% of those who scored in the normal/borderline range at 2 years remained within this range at 4.5 years. A small percentage of children who scored in the normal/borderline range at 2 years showed a later onset of behavioural problems by transitioning into the abnormal range at 4.5 years (7.7%-11%).

A notable percentage of children showed movement out of the abnormal range of behaviour at 4.5 years; 57.8% of children with abnormal scores improved their total difficulties by moving out of the abnormal range at 4.5 years. Similar percentages were found for most subscales (61%-65.7%) except for conduct problems, where 72.6% of children with age 2 abnormal scores improved at 4.5 years. A higher percentage of improvement for the conduct problems subscale, relative to the other SDQ measures, is not surprising. Many of the behaviours measured by the conduct problems subscale (e.g. temper tantrums, disobedience) are behaviours that typically occur during early childhood and decrease in frequency with age (Einon & Potegal, 1994; Jenkins et al., 1984). Therefore, this improvement in conduct problems from 2 to 4.5 years may simply reflect age-related changes in behaviour.

While it is encouraging to see that a substantial proportion of children showing serious early behavioural problems improved over the early childhood period, our results also indicate that many of the children displaying early behavioural problems persist in these difficulties. Over 40% of children with abnormal total difficulties at age 2 continued to show abnormal total difficulties at 4.5 years, with slightly lower percentages observed for most subscales (27.4%-39%). This percentage is similar to what was reported in the study by Mathieson and Sanson (2000), who found that 37% of children

with behavioural problems at 18 months were also classified as having problems at 30 months. It is important to note that these children with persistent difficulties make up only approximately 3-4% of our total sample, though this is similar to the proportion of children with persistent difficulties in the study by Mathieson and Sanson. Further, this proportion is to be expected, given that approximately 10% of children are categorised as showing serious behavioural difficulties at a single time point (D'Souza et al., 2017a).

We also examined the association between preschool behavioural stability and sociodemographic factors. Our descriptive analyses indicated that, relative to children with no behavioural difficulties during early childhood, children who showed behavioural difficulties during at least one time point had a greater proportion of mothers who were younger, Māori and Pacific and less educated, and were also more likely to live in highly deprived and urban areas. They were also more likely to be male and the result of an unplanned pregnancy. Those with persistent difficulties had a particularly higher proportion of the aforementioned characteristics relative to other groups. Teen parenting, lack of secondary school education and high area-level deprivation have previously been identified as risk factors for vulnerability in our cohort, with greater exposure to multiple risk factors being associated with poorer health outcomes from the immediate postnatal period through to 2 years (Morton, Carr, et al., 2014).

New Zealand studies examining ethnic disparities in preschool behavioural problems or psychosocial wellbeing are lacking, though studies with adolescent New Zealand samples have reported that Māori and Pacific children were more likely than NZ European children to experience behavioural difficulties (Noel et al., 2013). However, it is important to acknowledge that these results are purely descriptive in nature, and we

therefore cannot make claims about ethnic differences in behavioural difficulties based on the results of this study. The association between ethnicity and behavioural difficulties is likely to be complex; Gillies et al. (2014) have found that these ethnic disparities may be due to the influence of an accumulation of vulnerability risk factors earlier in life, including socioeconomic disadvantage and childhood trauma. In support of this, it was found that Māori and Pacific children within our cohort were more likely to be exposed to a greater number of antenatal vulnerability risk factors (Morton, Carr, et al., 2014). Therefore, the greater proportion of children with Māori and Pacific mothers within those showing behavioural difficulties is likely reflective of the greater exposure these ethnic groups have with socioeconomic disadvantage and early adversity. As such, results regarding ethnic differences should be interpreted with caution, and consider the broader social and historical factors likely contributing to these differences.

4.7. Conclusions

Our results ultimately show that the majority of children who present with abnormal behavioural scores at age 2 typically improved by 4.5 years. However, there was still a significant proportion of children with an abnormal categorisation at age 2 who persisted in their difficulties at 4.5 years. There was also a small percentage of children who initially did not show behavioural problems but were classified as having abnormal scores at 4.5 years. Further, each of these groups, but particularly those with persistent difficulties, had a larger proportion of children experiencing risk factors for vulnerability relative to children with no difficulties. This study was intended to be descriptive in nature, and therefore does not address the complex associations between preschool behavioural stability and sociodemographic factors, though *Growing Up in New Zealand*

aims to address this in future studies. Future research will also aim to identify proximal and distal family and environmental factors that may contribute to this persistence or change in problem behaviours. Nevertheless, findings from the current study are novel, given that, to our knowledge, we are the first to utilise the SDQ during multiple time points in the preschool period. Importantly, as our results indicate that some, but not all, children who show serious behavioural difficulties continue to persist in these difficulties across early childhood, repeated screening should be conducted for behavioural problems.

5. The association between persistence and change in early childhood behavioural problems and preschool cognitive outcomes (Study 5)

5.1. Chapter Prologue

The present study addressed the fifth research question: What are the cognitive difficulties associated with persistence and change in early childhood behavioural problems? To assess this, we evaluated whether showing total behavioural difficulties at 2 years (i.e. improved), 4.5 years (i.e. later or concurrent difficulties) or at both time points (i.e. persistent difficulties) were associated with an increased risk of cognitive delay relative to children with no difficulties throughout early childhood. It was decided that analyses would only focus on the persistence and change in total difficulties, due to concerns over the reliability of the subscales. Specific concerns included the low internal consistency for peer problems at both time points, and the missing item and low internal consistency corresponding to conduct problems at 4.5 years.

We refer to later difficulties as concurrent difficulties in the following chapter, as it occurred concurrently to when cognitive delays were assessed. The cognitive abilities evaluated at 4.5 years included receptive language, early literacy ability, and executive control. We were also interested in evaluating whether children showing behavioural difficulties at one or both time points were at an increased risk of showing comorbid delays across the cognitive measures assessed.

The cognitive outcomes were categorised into delayed and not delayed in the following study for two main reasons. Firstly, the categorisation allows inferences to be made about more clinically significant cognitive difficulties associated with early

childhood behavioural problems. Secondly, the categorisation allows us to look at comorbid delays across cognitive domains.

A copy of Study 5 is currently under review at *Frontiers in Psychology: Developmental Psychology*.

5.2. Abstract

The link between behavioural and cognitive difficulties is well established. However, research is limited on whether persistence and change in behavioural difficulties relates to cognitive outcomes, particularly during preschool. Here we used a large, population-based New Zealand birth cohort to investigate how persistence and change in serious behavioural problems from ages 2 to 4.5 years related to measures of cognitive delay at 4.5 years (N = 5885). The 90th percentile of the Strengths and Difficulties total difficulties score was used to identify children who showed serious behavioural difficulties at each time point, with children then categorised as showing no difficulties, improved behaviour, concurrent difficulties, and persistent difficulties. Cognitive measures included the Picture Peabody Vocabulary Test to assess receptive language, DIBELS letter naming fluency to indicate early literacy ability, and the Luria hand clap task to measure executive control. Children were also categorised into delayed and not delayed for each cognitive measure. Our results showed that only children with concurrent and persistent behavioural difficulties were at a greater risk of showing cognitive delay relative to children with no difficulties. These children were also more likely to show comorbid delays across multiple cognitive domains. Our findings suggest that efforts to target early behavioural problems should also consider any difficulties that the child may have in language and executive control.

5.3. Introduction

Early childhood behavioural difficulties have been linked to a range of negative physical, psychosocial and cognitive outcomes in later childhood, adolescence, and even adulthood (Fergusson et al., 2005, 1996; Jakobsen, Horwood, et al., 2012; McGee et al., 2002; Mistry et al., 2017; Odgers et al., 2007; Raudino et al., 2012). However, not all children who show early behavioural problems persist in these difficulties later on in life. Our research team has previously found that, of children who showed serious total behavioural difficulties at age 2, 57.8% of these individuals improved in their behaviour when assessed at 4.5 years (D'Souza, Underwood, Peterson, Morton, & Waldie, 2018).

To our knowledge, it is yet to be determined whether there is a differential risk of adverse outcomes for children who show persistent difficulties when compared to children who experience serious behavioural difficulties only at a single time point. For preschool children, this is particularly important to consider in the domain of cognition, as research has shown that preschool cognitive abilities, such as attention, inhibitory control, and language ability, have been linked to later academic outcomes at school age (Aram & Nation, 1980; Bull et al., 2008; Clark et al., 2010; Welsh et al., 2010).

The aforementioned cognitive skills are often limited in children with behavioural difficulties. Cross-sectional studies with preschool children have found that individuals with greater behavioural problems obtained lower scores in several measures of language ability, including receptive, expressive and pragmatic language (Gremillion & Martel, 2014; Sim et al., 2013), and showed poorer performance on executive functioning measures, such as inhibition (Raaijmakers et al., 2008) and broader executive control (Espy et al., 2011). Importantly, these associations are present in populations showing

clinically significant behavioural difficulties (Gremillion & Martel, 2014; Raaijmakers et al., 2008; Schoemaker, Mulder, Deković, & Matthys, 2013), as well as typically developing children (Espy et al., 2011; Sim et al., 2013).

Longitudinal studies evaluating how behavioural difficulties relate to later cognitive outcomes are limited, with studies generally focusing more on the relationship between behavioural problems and academic outcomes instead (Bulotsky-Shearer & Fantuzzo, 2011; Graziano et al., 2007). Further, longitudinal studies focusing explicitly on preschool measures of cognitive ability are lacking, with existing research primarily addressing how early cognitive difficulties relate to later behavioural problems, rather than vice versa. For example, Henrichs et al. (2013) found that vocabulary delay at 18 months and 30 months in a Dutch population-based sample were at an increased risk of externalising and internalising behaviour problems at 36 months, with children who showed persistent delay having the greatest risk. However, the association between cognitive difficulties and behavioural problems are likely bidirectional, particularly with language difficulties (Redmond & Rice, 1998). As such, it is important to also consider how early behavioural problems relate to later cognitive outcomes.

Using a large, population-based New Zealand birth cohort, the current study investigated the association between behavioural problems and cognitive outcomes. We examined whether behavioural difficulties at either 2 or 4.5 years, as well as persistence in behavioural problems across these two time points, related to measures of cognitive delay at 4.5 years. We hypothesised that children with at least one instance of behavioural difficulties would have an increased likelihood of cognitive delay in either receptive language, early literacy or executive control. We also investigated whether having either

a single instance of behavioural difficulties, or persistent problems, during early childhood were associated with a greater risk of comorbid delay across multiple cognitive domains.

5.4. Methods

5.4.1. Participants

Participants were members of a birth cohort, recruited for the longitudinal *Growing Up in New Zealand* study. Details of the study's design and recruitment procedure have been described previously (Morton et al., 2013; Morton, Grant, et al., 2014). Briefly, the cohort consists of a socioeconomically and ethnically diverse sample of 6853 children, recruited via 6822 pregnant women who had expected delivery dates between 25th April 2009 and 25th March 2010. Pregnant women were recruited from a geographical area that covers three contiguous District Health Board regions and contains approximately one third of the NZ birth population (Morton et al., 2013). We have previously shown that the cohort children are broadly generalizable to current NZ births (Morton et al., 2013).

Major data collection waves (DCWs) have occurred during late pregnancy, and when children were aged 9 months, 2 years, and 4.5 years. Computer Assisted Personal Interviews (CAPIs) were used at each face to face DCW to gather information, from the children and their mothers, relating to six inter-connected domains of child development: health and wellbeing; cognitive and psychosocial development; education; family and whānau (extended family); culture and identity; and neighbourhoods and societal context. Ethical approval was granted from the Ministry of Health Northern Y Regional Ethics Committee (NTY/08/06/055), and mothers provided informed written consent.

Children were included in the current study if their behaviour was assessed at both ages 2 and 4.5 years. The final sample consisted of 5885 children (86% of the Growing Up in New Zealand cohort).

5.4.2. Measures

Stability in behavioural difficulties. The mother-reported Strengths and Difficulties Questionnaire (SDQ) (R. Goodman, 1997) was used to measure behavioural difficulties when study members were aged 2 and 4.5 years. The preschool version of the SDQ was used when the children were aged 2 years, and the standard SDQ was used at 4.5 years. Details of the minor differences between the preschool and standard SDQ can be found on the SDQ website (www.sdqinfo.com) (Youth in Mind, 2014). The total difficulties score at ages 2 and 4.5 was used in the current study. Previous research with the cohort has shown that the SDQ shows acceptable psychometric properties when administered as early as 2 years (D'Souza et al., 2017a).

As we were interested in how persistence or change in serious behavioural difficulties relates to cognitive outcomes, a composite measure indicating the stability in behavioural difficulties was created. Firstly, SDQ total difficulties scores at both 2 and 4.5 years were dichotomised into normal/borderline and abnormal, based on whether scores fell into the clinically significant abnormal range; this cut-off was approximately the 90th percentile for each SDQ measure (D'Souza et al., 2017a; R. Goodman, 1997). Children were then categorised into the following groups: no difficulties (normal/borderline at 2 and 4.5 years), improved (abnormal at 2 years only), concurrent difficulties (abnormal at 4.5 years only), and persistent difficulties (abnormal at 2 and 4.5 years).

Cognitive measures.

Receptive language. An adapted version of the Picture Peabody Vocabulary Test (PPVT-III) was administered at 4.5 years to measure children's receptive language ability. This shortened PPVT was developed by the Longitudinal Study of Australian Children (LSAC) to measure receptive language at age 4-5 (C. L. Taylor, Christensen, Lawrence, Mitrou, & Zubrick, 2013). For our study, PPVT-III scores were calculated by taking the total number of correct responses and submitting it to an item response theory factor analysis. The final factor analysis adjusted PPVT-III score, which ranged from 0 to 40, was converted to a z score; those who scored one standard deviation below the mean were categorised as having delayed receptive language, and all other children were scored as not delayed.

Early literacy ability. The DIBELS letter naming fluency task (Good, Kaminski, Smith, Laimon, & Dill, 2003) was administered as a measure of children's early reading ability and phonological awareness. The task involves children being presented with randomly ordered upper- and lower-case letters, and asked to name each letter. Children were dichotomised so that those who were unable to name a single letter were labelled as showing delayed early literacy, and those who named one letter or more were labelled as not delayed.

Executive control. Executive control was measured using the Luria hand clap task; a modified version of the pencil tap task from the Luria-Nebraska Neuropsychological Battery (Golden, 1981; Golden, Hammeke, & Purisch, 1979). Detailed description of the task can be found elsewhere (Buckley et al., 2017). Briefly, the task involves reverse imitation, where the child has to perform the opposite action

modelled by the experimenter. Specifically, the child must clap twice when the experimenter claps once, and vice versa. The task requires the child to attend to the experimenter's actions, hold the two rules in mind, and inhibit their natural response to imitate the experimenter. There were 16 hand clap test trials, with children receiving 1 point per trial for correct execution of the action.

In the current study, the total Luria performance score was converted into a z score, then those who fell one standard deviation below the mean were categorised as having delayed inhibitory control, and all others were categorised as not delayed.

Number of cognitive delays. A composite measure indicating the total number of relative cognitive delays a child had was also created, based on three afore mentioned cognitive measures. Children were categorised as having no delay, a single delay or two or more delays in either receptive language, early literacy ability or executive control.

Control variables. Several variables likely to be associated with both behaviour and cognition, based on the literature, were controlled for in the current study. Control variables specific to the child included birthweight, gestational age, sex, and age in days when assessed at the 4.5 year DCW. Maternal variables controlled for included mother's education (no secondary school, secondary school/diploma/trade certificate, Bachelor's degree or higher), age (<20 years, 20-29 years, ≥30 years) and parity (first born or subsequent birth) at the antenatal DCW, as well as mother's ethnicity (European, Maori, Pacific, Asian, Other) and whether or not the pregnancy was planned. Area-level deprivation (high, medium and low) and rurality (urban or rural) at 4.5 years was also controlled for in analyses.

5.4.3. Data analysis

All statistical analyses were completed using R version 3.4.3. Using the function *glm*, multiple logistic regressions were fitted to evaluate how stability in behavioural difficulties related to each cognitive outcome measure, while controlling for the aforementioned control variables. Post-hoc multiple comparisons between each level of the behavioural stability variable were calculated using general linear hypothesis tests (function *glht* in package *multcomp;* Bretz, Hothorn, & Westfall, 2016), with a Tukey correction applied for multiple comparisons.

To evaluate the association between stability in behavioural difficulties and number of cognitive delays, a multinomial logistic regression was conducted. No cognitive delay and no behavioural difficulties was specified as the reference categories for the outcome and predictor variables, respectively.

Statistical significance for all analyses was given at a p-value of .05.

5.5. Results

Table 5.1 presents descriptive information for behavioural stability categories and control variables across each cognitive measure. Overall, 2752 children had no behavioural difficulties at 2 or 4.5 years and no cognitive delays (54.4% of those for whom there were full data). Thus, 45.6% of the sample, for whom there were full data, (n=2311) had some behavioural difficulties and/or at least one cognitive delay. Most of those with behavioural difficulties at either 2 and/or 4.5 years (58.9%) had at least one cognitive delay compared with only 35.8% of those with no behavioural difficulties.

The multiple comparison results from the general linear hypothesis tests are presented in Table 5.2. Our results show that children with concurrent behavioural

difficulties during early childhood had a 1.47 and 1.62 increase in the odds of having a receptive language and executive control delay, respectively, when compared to children with no behavioural difficulties during early childhood, *ps* < .05.

Further, children who showed persistent behavioural difficulties had a 1.65 and 1.74 greater odds of showing early literacy delay and executive control delay, respectively, when compared to children who showed no difficulties, *ps* < .05. No further comparisons were significant.

Results from the multinomial logistic regression are presented in Table 5.3. Children who showed behavioural difficulties at 2 years, but improved at 4.5 years had a 1.40 greater odds of showing a single delay across all three cognitive measures relative to children who showed no behavioural difficulties during early childhood, *p* < .05. Children who only showed concurrent behavioural problems had a 1.82 greater odds of displaying two or more cognitive delays, relative to children with no behavioural difficulties, *p* < .001. Further, children with persistent behavioural difficulties had a 1.57 greater odds of showing a single cognitive delay, and a 2.21 greater odds of showing multiple cognitive delays, relative to children with no behavioural difficulties, *ps* < .05.

Table 5.1.
Descriptive information for behavioural stability and control variables across each cognitive measure.

	Receptive language		Early literacy ability		Executive control		Number of cognitive delays		
	Not delayed n (%) or M (SD)	Delayed n (%) or M (SD)	Not delayed n (%) or M (SD)	Delayed n (%) or M (SD)	Not delayed n (%) or M (SD)	Delayed n (%) or M (SD)	No delays n (%) or M (SD)	Single delay n (%) or M (SD)	2+ delays n (%) or M (SD)
Behavioural stability									
No difficulties	3727 (87.3)	810 (70.8)	3732 (86.3)	729 (74.8)	3637 (86.5)	788 (74.8)	2752 (89.6)	1029 (81.3)	505 (69.5)
Improved	185 (4.3)	93 (8.1)	207 (4.8)	61 (6.3)	201 (4.8)	74 (7.0)	117 (3.8)	86 (6.8)	53 (7.3)
Concurrent difficulties	241 (5.6)	149 (13.0)	264 (6.1)	107 (11.0)	241 (5.7)	123 (11.7)	144 (4.7)	93 (7.4)	105 (14.4)
Persistent difficulties	116 (2.7)	92 8.0)	120 (2.8)	77 (7.9)	128 (3.0)	68 (6.5)	58 (1.9)	57 (4.5)	64 (8.8)
Mother's ethnicity									
European	2853 (66.8)	324 (27.7)	2721 (62.7)	425 (43.2)	2592 (61.3)	509 (48.1)	2150 (69.9)	649 (51.2)	238 (32.3)
Maori	466 (10.9)	238 (20.3)	451 (10.4)	224 (22.8)	516 (12.2)	163 (15.4)	280 (9.1)	195 (15.4)	153 (20.7)
Pacific	346 (8.1)	334 (28.5)	401 (9.2)	231 (23.5)	444 (10.5)	211 (20.0)	191 (6.2)	183 (14.4)	226 (30.6)
Asian/Other	607 (14.2)	275 (23.5)	766 (17.7)	104 (10.6)	679 (16.0)	174 (16.5)	457 (14.8)	240 (18.9)	121 (16.4)
Mother's education									
No secondary school	217 (5.1)	118 (10.1)	214 (4.9)	109 (11.1)	233 (5.5)	79 (7.5)	136 (4.4)	80 (6.3)	76 (10.3)
Secondary school/diploma/trade certificate	2119 (49.5)	761 (65.2)	2161 (49.8)	625 (63.6)	2155 (50.9)	639 (60.4)	1435 (46.6)	737 (57.9)	493 (67.0)
Bachelor's degree or higher	1942 (45.4)	289 (24.7)	1968 (45.3)	249 (25.3)	1846 (43.6)	340 (32.1)	1507(49.0)	456 (35.8)	167 (22.7)
Mother's age									
<20 years	137 (3.2)	89 (7.5)	146 (3.4)	68 (6.9)	159 (3.7)	58 (5.4)	86 (2.8)	54 (4.2)	56 (7.5)
20 to 29 years	1461 (34.1)	571 (48.5)	1562 (35.9)	415 (41.9)	1529 (36.1)	417 (39.2)	1004 (32.6)	548 (43.0)	317 (42.6)
30 years and over	2684 (62.7)	518 (44)	2642 (60.7)	507 (51.2)	2552 (60.2)	590 (55.4)	1991 (64.6)	673 (52.8)	371 (49.9)
Child's gender									
Male	2145 (49.5)	677 (56.3)	2166 (49.2)	587 (58.1)	2120 (49.4)	618 (57.0)	1474 (47.4)	699 (53.9)	439 (57.8)
Female	2186 (50.5)	525 (43.7)	2233 (50.8)	423 (41.9)	2171 (50.6)	467 (43.0)	1636 (52.6)	598 (46.1)	320 (42.2)
Parity									
First born	1848 (43.2)	450 (38.3)	1938 (44.6)	327 (33.2)	1760 (41.5)	463 (43.6)	1356 (44.0)	529 (41.6)	270 (36.5)
Subsequent birth	2431 (56.8)	724 (61.7)	2409 (55.4)	659 (66.8)	2476 (58.5)	599 (56.4)	1724 (56.0)	744 (58.4)	470 (63.5)

Table 5.1 Continued.

	Receptive language		Early literacy ability		Executive control		Number of cognitive delays		
	Not delayed n (%) or M (SD)	Delayed n (%) or M (SD)	Not delayed n (%) or M (SD)	Delayed n (%) or M (SD)	Not delayed n (%) or M (SD)	Delayed n (%) or M (SD)	No delays n (%) or M (SD)	Single delay n (%) or M (SD)	2+ delays n (%) or M (SD)
Planned pregnancy									
Yes	2865 (67.1)	535 (45.9)	2864 (66.1)	484 (49.4)	2708 (64.1)	603 (57.0)	2135 (69.4)	750 (59.2)	336 (45.7)
No	1403 (32.9)	631 (54.1)	1471 (33.9)	496 (50.6)	1516 (35.9)	454 (43.0)	940 (30.6)	516 (40.8)	399 (54.3)
Area-level deprivation									
Low	1508 (35.0)	195 (16.3)	1493 (34.1)	201 (20.1)	1409 (33.1)	265 (24.5)	1159 (37.5)	345 (26.7)	128 (17.0)
Medium	1630 (37.9)	363 (30.3)	1649 (37.7)	315 (31.4)	1577 (37.0)	368 (34.1)	1196 (38.7)	469 (36.4)	221 (29.3)
High	1164 (27.1)	639 (53.4)	1232 (28.2)	486 (48.5)	1276 (29.9)	447 (41.4)	734 (23.8)	476 (36.9)	405 (53.7)
Rurality									
Urban	3836 (89.2)	1135 (94.8)	3953 (90.4)	905 (90.3)	3834 (90.0)	997 (92.3)	2754 (89.2)	1177 (91.2)	701 (93.0)
Rural	466 (10.8)	62 (5.2)	421 (9.6)	97 (9.7)	428 (10.0)	83 (7.7)	335 (10.8)	113 (8.8)	53 (7.0)
Child's age (days) at assessment	1655.88 (45.76)	1663.23 (49.29)	1656.32 (45.89)	1659.81 (47.66)	1657.51 (46.78)	1658.06 (46.70)	1655.86 (45.67)	1657.79 (47.94)	1661.57 (47.76)
Birthweight (grams)	3537.31 (541.76)	3471.47 (580.83)	3527.64 (551.07)	3520.33 (545.35)	3535.66 (536.76)	3489.77 (601.49)	3546.02 (526.89)	3517.00 (582.58)	3480.45 (581.43)
Gestational age (weeks)	39.19 (1.68)	39.20 (1.76)	39.19 (1.70)	39.23 (1.59)	39.23 (1.63)	39.06 (1.93)	39.23 (1.61)	39.17 (1.79)	39.21 (1.74)

Table 5.2.
Results from the general linear hypotheses tests comparing behavioural stability categories for each cognitive measures.

	Receptive language				Early literacy ability				Executive control			
	B (SE)	OR	95% CI	z-value	*B* (SE)	OR	95% CI	z-value	*B* (SE)	OR	95% CI	z-value
Improved vs no difficulties	0.24 (0.15)	1.27	0.87-1.85	1.62	-0.05 (0.16)	0.95	0.63-1.45	-0.3	0.26 (0.15)	1.29	0.88-1.89	1.7
Concurrent vs no difficulties	0.38 (0.13)	1.47	1.06-2.03	3.03*	0.22 (0.14)	1.24	0.88-1.76	1.61	0.48 (0.13)	1.62	1.17-2.25	3.77**
Persistent vs no difficulties	0.37 (0.16)	1.45	0.96-2.19	2.27	0.50 (0.17)	1.65	1.07-2.53	2.96*	0.55 (0.17)	1.74	1.13-2.66	3.30*
Later onset vs improved	0.14 (0.18)	1.16	0.73-1.83	0.8	0.27 (0.20)	1.31	0.79-2.17	1.34	0.23 (0.18)	1.26	0.79-2.01	1.24
Persistent vs improved	0.13 (0.21)	1.14	0.67-1.93	0.64	0.55 (0.22)	1.73	0.99-3.03	2.48	0.30 (0.21)	1.35	0.79-2.31	1.41
Persistent vs concurrent	-0.01 (0.19)	0.99	0.61-1.61	-0.07	0.28 (0.20)	1.32	0.80-2.20	1.4	0.07 (0.20)	1.07	0.65-1.76	0.35

Note: $^{**}p \leq .001$, $^{*}p < .05$.
Analysis controlled for child's birthweight, gestational age, sex, age at assessment, mother's education, mother's age, mother's ethnicity, parity, planned pregnancy, and area-level deprivation.

Table 5.3.
Results from the multinomial logistic regression evaluating the association between behavioural stability and number of cognitive delays.

	1 delay vs no delay				2 or more delays vs no delay			
	B (SE)	OR	95% CI	z-value	*B* (SE)	OR	95% CI	z-value
Improved	0.34 (0.15)	1.4	1.03-1.90	2.18*	0.22 (0.19)	1.25	0.86-1.81	1.17
Concurrent	0.15 (0.15)	1.16	0.87-1.55	1.04	0.60 (0.16)	1.82	1.34-2.47	3.84**
Persistent	0.45 (0.20)	1.57	1.05-2.33	2.22*	0.79 (0.21)	2.21	1.47-3.33	3.78**

Note: $^{**}p < .001$, $^{*}p < .05$.
Analysis controlled for child's birthweight, gestational age, sex, age at assessment, mother's education, mother's age, mother's ethnicity, parity, planned pregnancy, and area-level deprivation.

5.6. Discussion

The aim of the current study was to evaluate how persistence and change in early childhood behavioural difficulties related to preschool cognitive delay. We hypothesised that children with at least a single instance of behavioural difficulties (i.e. those in the improved, concurrent and persistent difficulties categories) would show an increased risk of cognitive delay in either receptive language, early literacy ability or executive control, relative to children with no early childhood behavioural difficulties. Interestingly, our results indicated that only those with concurrent or persistent difficulties had an increased likelihood of showing cognitive delay; those who only showed behavioural difficulties at 4.5 years had nearly a 50% greater odds of receptive language delay, and a 63% greater odds of delay in executive control. Those with persistent behavioural difficulties had approximately a 65% and 75% greater odds of early literacy delay and executive control delay, respectively. Children who showed serious behavioural difficulties at age 2 years but later improved did not have an increased risk of cognitive delay when evaluating each cognitive measure individually.

Nevertheless, when compared to those with no behavioural difficulties, our results did indicate that children who improved still had an increased odds of 40% in showing a single delay relative to no delay across the three cognitive measures; however, they were not at an increased risk of showing delays across multiple domains. In contrast, children who showed concurrent and persistent behavioural difficulties were 80% and over 200% more likely to show multiple cognitive delays, respectively. Children with persistent behavioural problems were also nearly 60% more likely to show a single delay across any one of the three cognitive domains, relative to children with no difficulties.

Our results support cross-sectional studies showing an association between preschool behavioural problems and cognitive outcomes. For example, Sim et al. (2013) found that 30-month-old children showing abnormal SDQ scores at a universal assessment in Glasgow, Scotland were approximately three times more likely to show language delay than children with no abnormal scores. Further, Espy et al. (2011) found strong associations between behavioural problems and executive control in a sample of preschool-aged children. Our results are also consistent with studies using clinical samples, where preschool children with either diagnosed or clinically significant behavioural disorders showed poorer cognitive outcomes (Gremillion & Martel, 2014; Raaijmakers et al., 2008). However, our results add to these studies by demonstrating a longitudinal association between behaviour and cognition, specifically that persistent and not just concurrent behavioural problems are associated with delay in language and executive control. Further, to our knowledge, this is the first study to show that children with concurrent and persistent difficulties are more likely to show comorbid delays across multiple cognitive domains.

There are several potential mechanisms that may underlie the association between behavioural problems and cognitive delay. Two of these mechanisms relate to the Social Adaptation and Social Deviance Models, described by Redmond and Rice (1998). Both models were formed based on the association between behaviour and language, but can be extended to include other cognitive outcomes as well. The Social Adaptation Model postulates that behavioural difficulties occur as a result of the child's adaptations to their existing cognitive difficulties. In support of this, our results do show that children with concurrent cognitive difficulties are more likely to show cognitive delay, but this risk was

not present for children whose difficulties improved. However, according to the Social Deviance Model, comorbid cognitive and behavioural difficulties may be part of a single underlying trait that relates to both psychosocial behaviour and cognitive abilities. Furthermore, the comorbidity between behavioural problems and cognitive delay may also be due to a common causal factor, such as genetics (Plomin, Price, Eley, Dale, & Stevenson, 2002; Savitz, Solms, & Ramesar, 2006). Unfortunately, due to the nature of the data, we were unable to evaluate what these mechanisms may be; we do not have information available on candidate genes, nor the ability to calculate whether the association is due to shared genetic influences. We were also unable to obtain in depth cognitive measures prior to 4.5 years, therefore it is difficult to investigate whether cognitive challenges preceded behavioural difficulties in our sample. However, we encourage further research into this area.

Practical significance of our research can be applied to a nationwide health and development check offered to parents of 4 year olds in New Zealand, known as the B4 School Check (B4SC) (Ministry of Health, 2015a). The SDQ is used as a screening tool as part of the B4SC, and children identified as showing difficulties may be referred on to specialist services to assist with the child's behaviour (Ministry of Health, 2015b). In the 2015/2016 fiscal year, 92% of all 4 year olds registered with a primary healthcare organisation (estimated to be approximately 96% of all 4 year olds in New Zealand) participated in the B4SC (Shackleton et al., 2017); this indicates that the check is an important public health initiative. Our results suggest that children referred on from the B4SC as a result of abnormal SDQ scores may also have multiple cognitive demands that

will need to be addressed alongside their behavioural needs. Appropriate intervention for these children should ensure that they are well prepared for the demands of school.

The study would have benefited from a more direct measure of early literacy ability, as the DIBELS later naming fluency task is more of an indicator of early reading ability (Good et al., 2003). Using a greater range of cognitive measures in general would have also strengthened our findings. However, obtaining such measures would be challenging, due to the young age at which the cognitive assessments were administered, as well as the time and financial constraints associated with large-scale longitudinal data collection. Nevertheless, the *Growing Up in New Zealand* study is currently undergoing its 8 year DCW, and will be obtaining a more diverse range of academic and cognitive measures. Once data collection is complete, it will be of interest to address how the commencement of schooling might influences the relationship between behavioural difficulties and cognitive delay.

The current study ultimately shows that children with persistent and concurrent behavioural difficulties during early childhood are more likely to show delays in language and executive control than children with no behavioural difficulties. Further, these children are also at a greater risk of showing delays across multiple cognitive domains. However, on a positive note, children who improved in their behavioural difficulties were not at an increased risk of delay on individual cognitive measures. To our knowledge, this is the first study to evaluate how persistence and change in behavioural difficulties relates to preschool cognitive outcomes. These results will be important in informing initiatives that target early behavioural problems, as they suggest that these efforts also need to consider comorbid cognitive difficulties.

6. Determinants of persistence and change in early childhood behavioural problems: the roles of parenting and maternal mental health (Study 6)

6.1. Chapter Prologue

Study 6 investigated the determinants of persistence and change in total behavioural difficulties from ages 2 to 4.5 years (i.e. addressed the fifth research question). Due to the concerns over subscale reliability discussed in the prologues of Chapters 4 and 5, only the total difficulties measure was used in this study. Variables of interest included prenatal and postnatal maternal mental health, maternal depression at 4.5 years, parenting behaviours, inter-parental conflict and family social support. In addition, the following study investigated whether maternal depression and harsh parenting at 4.5 years mediated an association between inter-parental verbal and physical conflict and the development and persistence of early childhood behavioural problems. We were also interested in determining whether family social support (formal and informal) was associated with improved maternal mental health and reduced endorsement of harsh parenting styles at 4.5 years. Therefore, these results may possibly elucidate the pathways by which factors in the various ecological systems of the child influence their behavioural development.

All analyses controlled for individual traits, variables relating to the child's macrosystem, and any factors that were significantly associated with total difficulties at age 2 (Study 3) but were not of interest in the current study. Variables of interest fit well within Bronfenbrenner's (1979) bioecological model, demonstrated in Figure 6.1.

A copy of Study 6 has been submitted for review at *Journal of Child and Family Studies.* Supplementary material referred to in the study has been included in Appendix D.

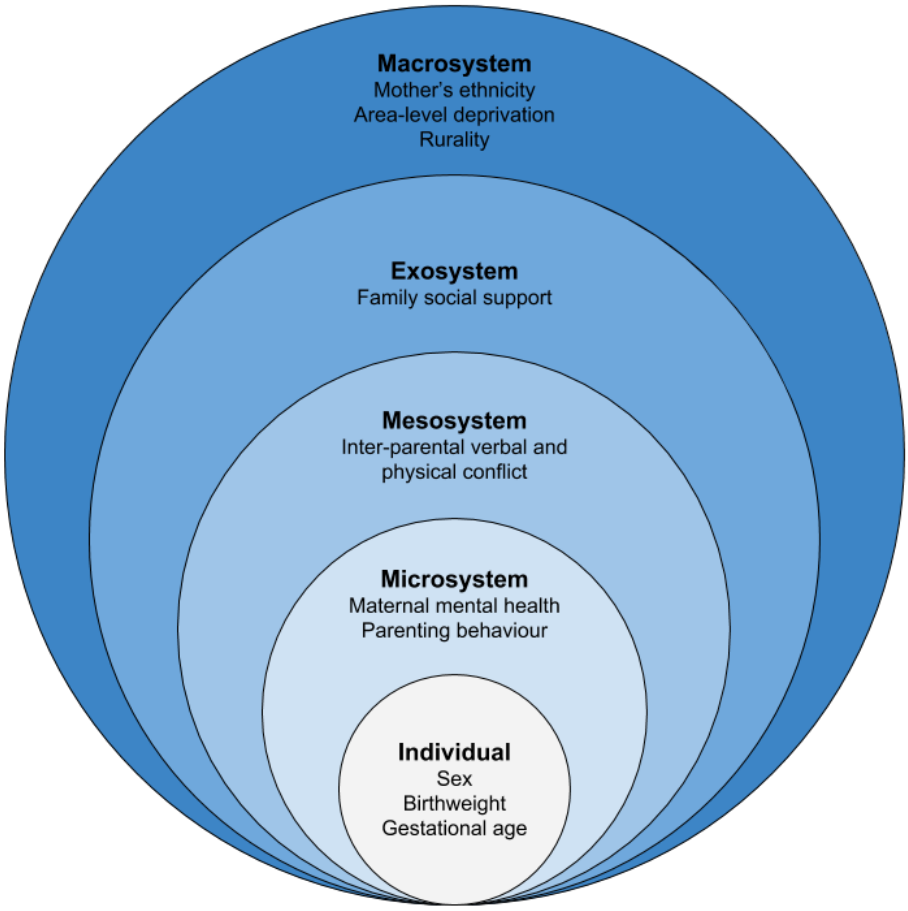

Figure 6.1. Indication of where Study 6's predictors of interest fit within the ecological systems corresponding to Bronfenbrenner's (1979) bioecological model. Certain control variables are also displayed within the appropriate ecological systems.

6.2. Abstract

Behavioural problems in early childhood are predictive of adverse outcomes later in life. However, recent research has indicated that behavioural problems are not

necessarily stable during this period. The current study aimed to investigate factors associated with the persistence and change in behavioural difficulties during early childhood, using data from the *Growing Up in New Zealand* birth cohort. Behavioural difficulties were assessed when children were aged 2 and 4.5 years (N = 5885). The 90th percentile of the Strengths and Difficulties total difficulties score was used to identify children who showed serious behavioural difficulties at each time point, with children then categorised as showing no difficulties, improved behaviour, later difficulties, and persistent difficulties. Predictors of interest related to maternal mental health and parenting behaviour, family social support and a history of exposure to physical and verbal conflict. We found that poor maternal mental health at multiple time points, authoritarian parenting style, and physical punishment parenting style were associated with an increased likelihood of developing behavioural difficulties at 4.5 years and showing persistent difficulties from 2 to 4.5 years. Physical punishment and authoritarian parenting styles also mediated the association between a history of verbal inter-parental conflict and both developing later difficulties and persistent difficulties, whereas only physical punishment parenting style mediated this association for a history of physical inter-parental conflict. The only factor that distinguished children who improved from children who persisted was maternal parenting self-evaluation at 9 months, with mothers who had a greater self-evaluation more likely to have children who persisted than improved. These results demonstrate the importance of considering the whole family unit when addressing children with behavioural difficulties.

6.3. Introduction

Early childhood is a key period of focus for the prevention of later adverse outcomes (Ministry of Health, 2016; Nelson et al., 2003), as behavioural problems during early childhood have been associated with an increased risk of psychosocial and physical health challenges (Bardone et al., 1998; Bittner et al., 2007; Fergusson & Horwood, 2001; Fergusson & Lynskey, 1998; Hayatbakhsh et al., 2008; Hofstra et al., 2002; Odgers et al., 2007). Furthermore, children with persistent behavioural problems show a greater societal cost in adulthood, as they are overrepresented in their usage of public services (Rivenbark et al., 2017). However, we have recently found that behavioural problems are not necessarily stable during the early childhood period (D'Souza, Waldie, Peterson, Underwood, & Morton, 2018). Specifically, we found that 57.9% of children with high total behavioural difficulties scores at 2 years improved in their behaviour when followed up at 4.5 years. In addition, a small proportion of children (8%) who did not show behavioural problems at 2 years later developed problems at 4.5 years. Understanding what factors contribute to the development of problems in early childhood, as well as the persistence and improvement in behavioural problems, is important for informing public health and intervention efforts.

Nau and Heckert (2013) noted that antenatal factors, family processes, and family social structure play key roles in influencing children's health and development. In support, we also found that antenatal maternal stress, verbal inter-parental conflict and low maternal self-evaluation were associated with an increased risk of behavioural difficulties at 2 years (D'Souza, Waldie, et al., in press). Nonetheless, there is limited knowledge on what factors influence persistence and change in preschool behavioural

difficulties. The few studies that have been conducted generally investigate factors associated with persistent and increasing behavioural problems, with maternal depression consistently identified as a risk factor (Galéra et al., 2011; Mathiesen & Sanson, 2000). However, the role of other family processes, such as parenting and inter-parental conflict have not been adequately investigated.

Several studies have linked negative parenting styles and behaviour to child behavioural difficulties. Specifically, parenting styles that include physical punishment have been associated with greater aggression and externalising behaviour at age 5 (MacKenzie et al., 2012; C. A. Taylor et al., 2010). An authoritarian parenting style, characterised by low warmth and high control, has also been linked to greater internalising and externalising behaviour in school-age children, whereas authoritative parenting, characterised by high warmth and high control, was found to be negatively associated with internalising and externalising behaviour in the same sample (Alizadeh et al., 2011). A study with adolescents also found that an authoritative parenting style was associated with greater resilience (Kritzas & Grobler, 2005). Therefore, although physical punishment parenting and authoritarian parenting styles can contribute to the development of behavioural problems, authoritative parenting with high warmth may protect children from developing behavioural difficulties, or contribute to an improvement in difficulties.

Considering the influence of inter-parental conflict on the stability of preschool behavioural problems is also important. Aside from several studies that have linked inter-parental verbal and physical conflict to behavioural problems in children (Graham-Bermann, Gruber, Howell, & Girz, 2009; Martinez-Torteya et al., 2009; McDonald et al.,

2007), there is also evidence to suggest that children under the age of 6 have a greater risk of being exposed to domestic conflict, particularly violence towards another family member (Fantuzzo et al., 1997). Our previous research focusing on behavioural problems at age 2 found that verbal but not physical conflict between mothers and their partner was associated with total problem scores (D'Souza, Waldie, et al., in press). Our analysis also adjusted for maternal mental health and parenting (specifically parenting self-evaluation). In keeping with the spillover hypothesis, these are factors thought to mediate the association between parental conflict and child behaviour. That is, according to the spillover hypothesis, conflict within one family system, such as the inter-parental system, may have negative influences over another family system, such as the parent-child relationship, by influencing parenting and mental health (Erel & Burman, 1995; Krishnakumar & Buehler, 2000). In support, poorer maternal mental health and harsher parenting has been found to mediate the association between domestic violence and behavioural problems at 12 months (Levendosky et al., 2006) and at 5 years (C.-C. Huang et al., 2010). As such, it would be of interest to evaluate whether maternal mental health and parenting styles also mediate the association between inter-parental conflict and the persistence of early childhood behavioural difficulties.

The current study analysed data from the *Growing Up in New Zealand* cohort to investigate factors associated with persistence and change in behavioural difficulties during early childhood. Behavioural difficulties were assessed when children were aged 2 and 4.5 years. Factors of interest included maternal mental health (assessed during pregnancy, at 9 months, and 4.5 years), parenting practices (assessed at 9 months, and 4.5 years), social support at 9 months, and history of exposure to physical and verbal inter-

parental conflict. We evaluated factors significantly associated with children who developed behavioural difficulties from 2 to 4.5 years compared with those who did not develop difficulties. We then investigated whether parenting factors at age 4.5 years (specifically authoritarian and physical punishment parenting styles) and maternal mental health at 4.5 years mediated an association between history of physical and verbal conflict and the development of behavioural difficulties from 2 to 4.5 years. We also evaluated what factors distinguish children with persistent behavioural difficulties from children who improve (i.e. show behavioural difficulties only at 2 years), develop later difficulties (i.e. show difficulties only at 4.5 years), and children who showed no behavioural difficulties. Furthermore, we investigated whether parenting factors and maternal mental health at 4.5 years mediated an association between history of inter-parental conflict and persistent behavioural difficulties in early childhood. Finally, we evaluated whether the level of social support available to mothers was associated with better mental health and different parenting styles.

6.4. Methods

6.4.1. Participants

Participants were members of the longitudinal *Growing Up in New Zealand* birth cohort. The design and recruitment procedure of the study have been detailed elsewhere (Morton et al., 2013; Morton, Grant, et al., 2014). Briefly, the cohort consists of children born to 6822 pregnant women with expected delivery dates between 25th April 2009 and 25th March 2010. Pregnant women were recruited from a geographical area that covers three contiguous District Health Board regions and contains approximately a third of the New Zealand birth population (Morton et al., 2013). Study members are

socioeconomically and ethnically diverse, and broadly generalizable to current NZ births (Morton et al., 2013).

Major data collection waves (DCWs) were carried during late pregnancy, and when the children were aged 9 months, 2 years, and 4.5 years of age. Information was collected at face to face DCWs via Computer Assisted Personal Interviews (CAPIs), and related to six inter-connected domains of child development: health and wellbeing; cognitive and psychosocial; education; family and whānau (extended family); culture and identity; and neighbourhoods and societal context. The Ministry of Health Northern Y Regional Ethics Committee (NTY/08/06/055) granted ethics approval for the study, with mothers providing informed written consent.

Children were included in the current study if their behavioural difficulties were measured at both the 2 year and 4.5 year DCWs (N = 5885). There were 348 children lost to follow up from the age 2 DCW to the 4.5 year DCW, though 171 children not assessed at 2 years returned for the 4.5 year DCW. Our analyses show that children lost to follow up were more likely to have mothers who were younger, less educated, and non-European (*ps* < .05). They were also more likely to be part of an unplanned pregnancy, come from highly deprived and urban regions, and shave behavioural difficulties at age 2 (*ps* < .05).

6.4.2. Measures

Behavioural difficulties. The Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997) was used to measure early childhood behavioural difficulties. Mothers answered the preschool version of the SDQ when children were aged 2 years, and the standard SDQ when children were 4.5 years old. The minor differences between the

preschool and standard SDQ are described on the SDQ website (www.sdqinfo.com; Youth in Mind, 2014). We have previously demonstrated that the SDQ has acceptable psychometric properties within our cohort (D'Souza et al., 2017b, 2017a).

A composite measure of the stability of serious behavioural difficulties was created using SDQ total difficulties scores at 2 and 4.5 years. Using a clinically significant cut-off of approximately the 90th percentile (D'Souza et al., 2017a; R. Goodman, 1997), total difficulties at both ages 2 and 4.5 years were dichotomised into normal/borderline and abnormal. Children were then categorised as either showing no difficulties (normal/borderline at 2 and 4.5 years; n = 4899), improved (abnormal at 2 years only; n = 323), later difficulties (abnormal at 4.5 years only; n = 428), or persistent difficulties (abnormal at 2 and 4.5 years; n = 235).

Maternal mental health. Measures relating to mothers' mental health were obtained during the antenatal, 9 month and 4.5 year DCWs. During the antenatal period, the Perceived Stress Scale (PSS; Cohen, Kamarck, & Mermelstein, 1983) was used to measure perceived stress during pregnancy. The Edinburgh Postnatal Depression scale (EPDS; Cox, Holden, & Sagovsky, 1987) was used to measure maternal depression during the antenatal period and at 9 months (Underwood, Waldie, D'Souza, Peterson, & Morton, 2017). The EPDS ranges from 0 to 30, and women who scored 13 or more were categorised as having clinically significant depressive symptoms (Waldie et al., 2015). Postnatal anxiety was measured using the Generalised Anxiety Disorder 7 (GAD-7; Spitzer, Kroenke, Williams, & Löwe, 2006) at the 9 month DCW. Consistent with the cut-offs recommended by Spitzer et al., mothers were categorised as having minimal to mild anxiety (scores of 0 to 9), or moderate to severe anxiety (scores of 10 to 21). At the

4.5 year DCW, the Patient Health Questionnaire (PHQ-9; Kroenke & Spitzer, 2002) was used to measure maternal depression. Scores ranged from 0 to 27; women with a score of 10 or more were categorised as having clinically significant depressive symptoms (Kroenke & Spitzer, 2002).

Maternal parenting behaviour. Mothers' evaluation of themselves as a parent was assessed when children were 9 months old, and maternal parenting practices were assessed when children were aged 4.5 years. Mother's parental self-evaluation was measured using the Evaluation subscale from the "What Being a Parent of a Baby is Like" instrument (Pridham & Chang, 1989). The subscale evaluates mothers' satisfaction in being a parent and caring for their child, their perception of how well they know their child, and the extent to which their parental self-expectations are met.

At the 4.5 year DCW, a short version of the Parenting Practices Questionnaire (PPQ) (C. C. Robinson, Mandleco, Olsen, & Hart, 1995) was used to measure parenting styles. The PPQ is a parent-report assessment of types of parenting and specific parenting practices consistent with established concepts of authoritative, authoritarian, and permissive styles of parenting. A subset of 21 items from the original 62-item questionnaire was selected to reflect a range of practices across all parenting styles. For each item, mothers were asked to rate how often they carried out a practice on a five-point scale; from Never to Always (scored 1-5).

Exploratory Factor Analysis with varimax rotation was conducted and revealed a four component solution. Confirmatory Factor Analysis was then conducted and revealed that the four factor model showed acceptable fit: $\chi^2_{(164)} = 8.18$; CFI = .92; RMSEA = .05; SRMR = .04; gamma hat = 0.96. The four factors identified corresponded to

Authoritative parenting (example item “I encourage him/her to talk about his/her troubles”), Authoritarian parenting (example item “I yell or shout when he/she misbehaves”), Physical Punishment parenting style (example item “I smack him/her when he/she is disobedient”), and Permissive parenting (example item “I find it difficult to discipline him/her”). Cronbach’s alpha coefficients were acceptable for all parenting measures ($\alpha > 0.70$), except Permissive parenting ($\alpha = 0.42$). Therefore, only Authoritative parenting, Authoritarian parenting, and Physical Punishment parenting style were used in the current study. Scores for each parenting style reflected its average item score, and therefore scores for each measure could range from 1 to 5.

Inter-parental conflict. Mothers were asked about physical and verbal conflict between themselves and their partners at 9 month and 4.5 year DCWs. At both DCWs, inter-parental physical and verbal conflict were measured using three items each, which asked about the frequency of conflict behaviours in the past four weeks. For example, for verbal conflict at 4.5 years, one of the items states “Your partner yells at you when they are angry”; for physical conflict, one of the items states “Your partner pushes or shoves you or pulls your hair”. Responses were given on a 7-point Likert scale, ranging from 1 (*Never*) to 7 (*All the time*). Items corresponding to each measure of conflict have been used previously in a NZ population, and have shown satisfactory reliability (Pryor, 2004).

As inter-parental verbal and physical conflict were measured at two time points, we created two new composite measures indicating history of inter-parental verbal conflict, and history of inter-parental physical conflict. To do this, categorical measures of both physical and verbal conflict were created at each time point, to indicate exposure to a significant level of conflict. For verbal conflict, significant exposure was determined

if mothers selected *Quite often, Extremely often,* or *All the time* for any one of the three verbal conflict items at each time point. Mothers were defined as having a history of verbal conflict if they were classified as having significant exposure to verbal conflict at 9 months and/or at 4.5 years. As physical conflict is arguably more severe than verbal conflict, significant exposure was determined if mothers had any level of exposure to physical conflict (i.e. anything above 1*(Never)* on the 7-point Likert scale, ranging from *Almost never* to *All the time*). Mothers were defined as having a history of physical conflict if they were classified as having significant exposure to physical conflict at 9 months and/or 4.5 years.

Family social support. At the 9 month DCW, mothers reported on the level of informal and formal support available to the family using the Family Support Scale (Dunst et al., 1984). The informal support subscale indicates the extent of support that mothers feel that they receive from their family and friends. In contrast, the formal support subscale measures how helpful mothers perceive formal sources of support to be (e.g. health and child-care professionals). Each item asks how helpful a specific source of support was, with items corresponding to each scale summed to give a total measure of formal and informal support.

Control variables. Variables controlled for in the current study included mother's ethnicity (European, Maori, Pacific, Asian/Other), education (no secondary school, secondary school/diploma/trade certificate, Bachelor's degree or higher), and age when pregnant (<20 years, 20-29 years, ≥30 years). Parity (first born or subsequent birth), whether or not the pregnancy was planned, exclusive breastfeeding duration (<6 months, 6 months or more), and 4.5 year area-level deprivation (high, medium, and low)

were also controlled for. Control variables specific to the child included child's gender, gestational age, and birthweight. Selection of control variables were based on potential sociodemographic influences and factors that were significantly associated with total difficulties at age 2 years (D'Souza, Waldie, et al., in press).

6.4.3. Data analysis

Univariate associations. Univariate associations between the behavioural stability measure and predictor variables were conducted. Associations between behavioural stability and categorical variables were examined using chi-square analyses, whereas associations between behavioural stability and continuous variables were assessed using Analyses of Variance (ANOVAs).

Part One. To address our initial research question on what factors determine the development of serious behavioural difficulties between 2 to 4.5 years, a binomial logistic regression analysis was conducted. Our outcome variable was the development of behavioural problems from ages 2 to 4.5 years, therefore only children with no behavioural problems at age 2 were used in the current analyses (i.e. children who were categorised as showing no difficulties or later difficulties). Predictors in our model included perceived stress and depression during pregnancy, postnatal maternal anxiety and depression, maternal parenting self-evaluation, informal and formal support, history of inter-parental verbal and physical conflict, physical punishment, authoritative and authoritarian parenting styles, and maternal depression when the child was 4.5 years old. The model was adjusted for the aforementioned control variables.

We then investigated whether negative parenting behaviours and maternal mental health at 4.5 years mediated an association between history of inter-parental verbal and

physical conflict and our outcome variable. A multiple mediation analysis was conducted using structural equation modelling, with all variables treated as observed. History of inter-parental verbal conflict and history of inter-parental physical conflict were included as predictors in our model, with physical punishment style, authoritarian parenting, and maternal depression at 4.5 years specified as mediators. In addition, we evaluated whether informal and formal support were associated with any of our proposed mediating variables. The analysis also adjusted for variables that were significant in the binomial logistic regression.

Part Two. To evaluate the determinants of persistent behavioural difficulties, a multinomial logistic regression was conducted. Stability in behavioural difficulties was the outcome variable, with persistent difficulties specified as the reference group. Predictors in the current model were the same as those included in the binomial logistic regression (perceived stress and depression during pregnancy, postnatal maternal anxiety and depression, maternal parenting self-evaluation, informal and formal support, history of inter-parental verbal and physical conflict, parenting styles, and maternal depression when the child was 4.5 years old). The control variables described above were also adjusted for in the model.

As we were also interested in whether the same mediation effects were observed for those with persistent behavioural difficulties, we repeated the multiple mediation analysis described in Part One, but changed the outcome variable to the development of persistent behavioural problems from 2 to 4.5 years (i.e. children who were categorised as showing no difficulties or persistent difficulties).

All analyses were conducted in R version 3.4.3. The core R package Stats and package VGAM (Yee, 2008) were used to conduct the binomial logistic and multinomial logistic regressions, respectively. The multiple mediation analyses were conducted using the statistical package lavaan (Rosseel, 2012), and bootstrapping was used to compute standard errors and confidence intervals. Due to the nature of the multiple mediation analysis, only binary or continuous variables could be used. Therefore, any variables with more than two levels were re-categorised as binary if needed. These variables included mother's age when pregnant (<20 years, ≥20 years), mother's ethnicity (European, non-European), and area-level deprivation (high, medium/low). Statistical significance was given at an alpha level of .05 for all analyses.

6.5. Results

6.5.1. Descriptive statistics and univariate associations

Descriptive statistics for categorical and continuous measures across behavioural stability profiles are presented in Tables 6.1 and 6.2, respectively. Results from the chi-square analyses investigating univariate associations between early childhood behavioural stability and categorical outcomes are also presented in Table 6.1. Significant associations were found between behavioural stability and all categorical measures (i.e. prenatal depression, postnatal anxiety and depression, history of verbal and physical conflict, and maternal depression at 4.5 years; *ps* < .001). Significant associations were also observed between behavioural stability and all continuous measures, except for authoritative parenting. Specifically, results indicate that scores were not the same across behavioural stability profiles for prenatal stress, maternal parenting self-evaluation, informal and formal support, physical punishment style and authoritarian parenting (*ps* <

.05). Interestingly, despite evidence of mean differences, mean scores for physical punishment and authoritarian parenting styles were generally low across behavioural stability profiles, suggesting somewhat low endorsement of these parenting styles.

Table 6.1.
Descriptive statistics and univariate associations between behavioural stability profiles and categorical measures.

	No difficulties n (%)	Improved n (%)	Later difficulties n (%)	Persistent n (%)	X^2
Prenatal depression					
Not depressed	4044 (90.5)	218 (76.5)	314 (79.7)	154 (77.0)	114.28**
Depressed	423 (9.5)	67 (23.5)	80 (20.3)	46 (23.0)	
Postnatal anxiety					
Minimal to mild	4510 (94.4)	264 (84.6)	352 (84.4)	183 (81.7)	130.89**
Moderate to severe	269 (5.6)	48 (15.4)	65 (15.6)	41 (18.3)	
Postnatal depression					
Not depressed	4499 (93.9)	271 (86.9)	360 (85.9)	184 (82.1)	87.44**
Depressed	294 (6.1)	41 (13.1)	59 (14.1)	40 (17.9)	
History of verbal conflict					
No	3620 (77.6)	205 (70.9)	254 (67.0)	131 (64.5)	42.05**
Yes	1045 (22.4)	84 (29.1)	125 (33.0)	72 (35.5)	
History of physical conflict					
No	4185 (89.7)	229 (79.2)	299 (78.9)	153 (75.4)	93.63**
Yes	480 (10.3)	60 (20.8)	80 (21.1)	50 (24.6)	
Maternal depression at 4.5 years					
Not depressed	4600 (94.5)	269 (84.3)	318 (75.0)	178 (76.4)	301.99**
Depressed	269 (5.52)	50 (15.7)	106 (25.0)	55 (23.6)	

Note: $^{**}p \leq .001$.

Table 6.2.
Descriptive statistics and univariate associations between behavioural stability profiles and continuous variables.

	No difficulties M (SD)	Improved M (SD)	Later difficulties M (SD)	Persistent M (SD)	F-value
Prenatal perceived stress	12.35 (6.13)	16.54 (6.55)	15.39(6.61)	17.09 (6.24)	93.94**
Maternal evaluation	59.89 (4.48)	58.95 (5.20)	59.82 (4.94)	60.00 (4.86)	4.22*
Informal support	21.18 (5.62)	20.17 (5.91)	20.32 (6.00)	20.63 (5.97)	6.09**
Formal support	18.72 (4.52)	17.68 (5.01)	18.14 (4.63)	16.91 (4.49)	16.68**
Authoritative parenting	4.46 (0.43)	4.44 (0.45)	4.43 (0.50)	4.44 (0.49)	0.76
Physical punishment style	1.76 (0.53)	2.06 (0.66)	2.22 (0.80)	2.39 (0.83)	177.60**
Authoritarian parenting	2.15 (0.56)	2.37 (0.66)	2.48 (0.74)	2.62 (0.80)	94.40**

Note: $^{**}p \leq .001$, $^{*}p \leq .05$.

6.5.2. Part One

Results from the binary logistic regression are presented in Table 6.3. Our results indicated that children whose mothers experienced moderate to severe levels of postnatal anxiety had a 68% greater odds of developing behavioural difficulties from 2 to 4.5 years, relative to mothers who experienced minimal to mild postnatal anxiety (OR = 1.68, $p < .05$). Greater physical punishment style (OR = 1.59, $p < .001$) and authoritarian parenting (OR = 1.63, $p < .001$) also increased a child's odds of developing serious behavioural difficulties from 2 to 4.5 years. Children whose mothers were depressed when their child was 4.5 years old had a nearly 3 times greater odds of developing behavioural difficulties from 2 to 4.5 years relative to children whose mothers who were not depressed (OR = 2.92, $p <.001$) .

Following this, the multiple mediation analysis was conducted, adjusting for variables significant in our binomial logistic regression (i.e. postnatal anxiety and significant control variables – see Table S1). Direct and indirect effects on our outcome from history of inter-parental verbal conflict and history of inter-parental physical conflict are presented in Figure 6.2. Standardised coefficients have been presented.

Figure 6.2 shows that physical punishment parenting style ($B = 0.05$, $SE = 0.01$, $\beta = 0.11$, $p < .001$), authoritarian parenting ($B = 0.04$, $SE = 0.01$, $\beta = 0.08$, $p < .001$), and maternal depression at 4.5 years ($B = 0.14$, $SE = 0.03$, $\beta = 0.14$, $p < .001$) significantly predicted the development of serious behavioural problems. Figure 6.2 also demonstrates that history of verbal conflict was a significant predictor of physical punishment parenting style ($B = 0.15$, $SE = 0.02$, $\beta = 0.11$, $p < .001$) and authoritarian parenting ($B = 0.26$, $SE = 0.02$, $\beta = 0.19$, $p < .001$), but not maternal depression at 4.5 years ($B = 0.01$,

SE = 0.01, β = 0.03, $p > .05$). Consequently, there were only significant indirect effects through physical punishment style (*B* = 0.01, *SE* = 0.002, β = 0.01, $p < .001$) and authoritarian parenting (*B* = 0.01, *SE* = 0.002, β = 0.02, $p < .001$), indicating that they were significant mediators of the association between history of verbal conflict and the development of behavioural difficulties. History of verbal conflict had no statistically significant direct effect on later difficulties when controlling for mediators (*B* = 0.002, *SE* = 0.01, β = 0.004), indicating full mediation. Contrasts were calculated to compare the indirect effects of physical punishment parenting style and authoritarian parenting, but this was not significant.

Figure 6.2 further demonstrates that history of inter-parental physical conflict was a significant predictor of physical punishment parenting style (*B* = 0.15, *SE* = 0.02, β = 0.11, $p < .001$), but not authoritarian parenting (*B* = 0.03, *SE* = 0.03, β = 0.02) or maternal depression at 4.5 years (*B* = 0.03, *SE* = 0.01, β = 0.04). As such, only the indirect effect for physical punishment parenting style was significant (*B* = 0.01, *SE* = 0.002, β = 0.01, $p \leq .001$). There was also no statistically significant direct effect of history of inter-parental physical conflict on later difficulties when controlling for mediators (*B* = 0.02, *SE* = 0.01, β = 0.03), indicating full mediation.

Our analyses also revealed that formal support significantly predicted physical punishment parenting style, such that higher levels of formal support were associated with lower physical punishment parenting style (*B* = -0.01, *SE* = 0.002, β = -0.05, $p \leq .001$). Greater informal support was predictive of increased physical punishment

parenting style (B = 0.004, SE = 0.002, β = 0.04, $p \leq .012$), but a reduced likelihood of maternal depression at 4.5 years (B = -0.002, SE = 0.001, β = -0.04, $p < .05$).

Table 6.3.
Binomial logistic regression predicting the development of difficulties from 2 to 4.5 years

	B (SE)	OR (95% CI)	z-value
Prenatal perceived stress	0.01 (0.01)	1.01 (0.98, 1.03)	0.50
Prenatal depression			
Not depressed			
Depressed	-0.02 (0.21)	0.98 (0.65, 1.47)	-0.09
Postnatal anxiety			
Minimal to mild			
Moderate to severe	0.52 (0.25)	1.68 (1.02, 2.71)	2.08*
Postnatal depression			
Not depressed			
Depressed	-0.05 (0.25)	0.95 (0.57, 1.55)	-0.20
Maternal evaluation	-0.01 (0.02)	0.99 (0.96, 1.02)	-0.53
Informal support	-0.01 (0.01)	0.99 (0.96, 1.01)	-0.99
Formal support	0.01 (0.01)	1.01 (0.98, 1.04)	0.58
History of verbal conflict			
No			
Yes	0.08 (0.15)	1.08 (0.80, 1.46)	0.52
History of physical conflict			
No			
Yes	0.18 (0.18)	1.20 (0.84, 1.70)	1.00
Authoritative parenting	-0.23 (0.15)	0.79 (0.59, 1.07)	-1.54
Physical punishment style	0.46 (0.11)	1.59 (1.28,1.97)	4.21**
Authoritarian parenting	0.49 (0.12)	1.63 (1.30, 2.05)	4.26**
Maternal depression at 4.5 years			
Not depressed			
Depressed	1.07 (0.18)	2.92 (2.03, 4.16)	5.87**

Note: **$p \leq .001$, *$p \leq .05$.

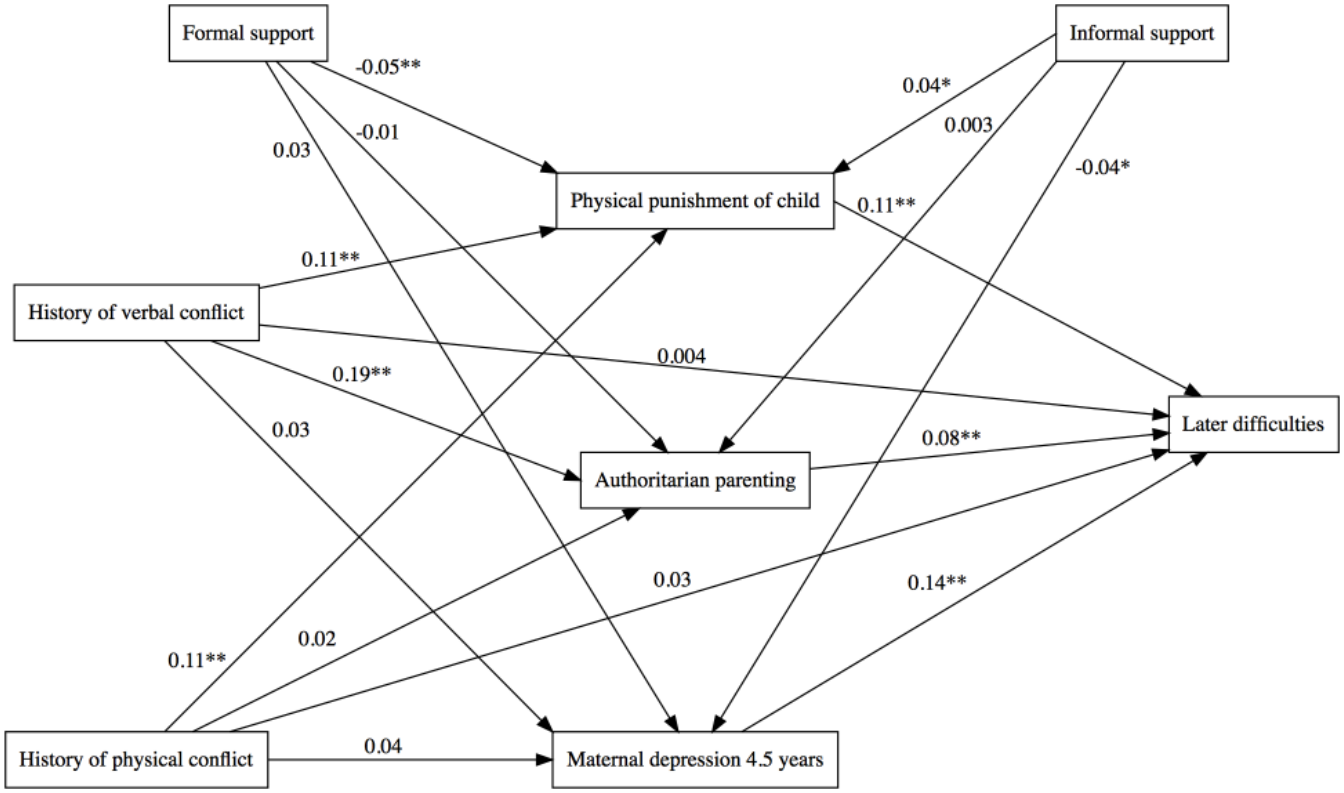

Figure 6.2. Multiple mediation model investigating predictors of later behavioural difficulties. Standardised coefficients are presented. Model adjusts for postnatal anxiety, mother's age when pregnant, mother's ethnicity and education, area-level deprivation, and child's sex. $^{**}p \leq .001$, $^{*}p \leq .05$.

6.5.3. Part Two

Results from the multinomial logistic regression are presented in Table 6.4, with both odds ratios and inverse odds ratios provided. As persistent difficulties was used as the reference level in our analysis, odds ratios were calculated based on the odds of classifying as one of the alternative behavioural stability levels (i.e. no difficulties, improved, or later difficulties) relative to persistent difficulties. However, for ease of

interpretation, we report on the inverse odds ratio, so that we are referring to the odds of being classified as having persistent difficulties.

Our results indicate that individuals whose mothers experienced greater perceived stress during pregnancy had an increased odds of being categorised as having persistent difficulties compared to no difficulties (OR = 1.05, $p < .05$), and an increased odds of having persistent difficulties compared to later difficulties (OR = 1.05, $p < .05$). Physical punishment style, authoritarian parenting and maternal depression at 4.5 years distinguished children with persistent difficulties from those with no difficulties. Specifically, children exposed to greater physical punishment (OR = 1.60, $p \leq .001$) or greater authoritarian parenting styles (OR = 2.15, $p < .001$) had an increased odds of showing persistent difficulties than no difficulties; children whose mothers were depressed at 4.5 years had a 2.23 times greater odds of showing persistent difficulties than no difficulties, relative to children whose mothers were not depressed ($p \leq .001$). When examining what factors were associated with an increased likelihood of showing persistent difficulties compared to improved behaviour, only maternal parenting self-evaluation was statistically significant; specifically, mothers who had a greater evaluation of themselves as a parent had an increased odds of having a child who persisted in their difficulties, rather than improved (OR = 1.06, $p < .05$).

We then conducted the multiple mediation analysis, adjusting for variables that were significant in predicting a difference in odds for persistent difficulties compared to no difficulties (i.e. prenatal perceived stress and significant control variables – see Table S2). Direct and indirect effects from history of verbal conflict and history of inter-

parental physical conflict on our outcome of persistent difficulties are shown in Figure 6.3. Standard coefficients have been presented.

Consistent with the results from the multinomial logistic regression, physical punishment parenting style (B = 0.04, SE = 0.01, β = 0.12, p < .001), authoritarian parenting (B = 0.03, SE = 0.01, β = 0.09, p < .001), and maternal depression at 4.5 years (B = 0.08, SE = 0.02, β = 0.10, p < .001) were associated with the development of persistent behavioural difficulties. Figure 6.2 shows that history of verbal conflict was a significant predictor of physical punishment (B = 0.12, SE = 0.02, β = 0.09, p < .001), authoritarian parenting (B = 0.23, SE = 0.02, β = 0.18, p < .001), and maternal depression at 4.5 years (B = 0.02, SE = 0.01, β = 0.04, p < .05). However, only the indirect effects of physical punishment parenting style (B = 0.01, SE = 0.001, β = 0.01, $p \leq .001$) and authoritarian parenting (B = 0.01, SE = 0.002, β = 0.02, p < .001) were statistically significant, indicating that these variables (but not maternal mental health when the child was 4.5 years old) mediated the association between history of verbal conflict and persistent behavioural difficulties. As history of inter-parental verbal conflict was not a significant predictor of persistent difficulties when controlling for our mediating variables (B = 0.002, SE = 0.01, β = 0.003), physical punishment style and authoritarian parenting appear to fully mediate this association. Comparison of the indirect effects of physical punishment and authoritarian parenting styles indicated that they were not significantly different.

Figure 6.3 further shows that history of inter-parental physical conflict was only a significant predictor of physical punishment parenting styles (B = 0.12, SE = 0.03, β =

0.07, $p < .001$). Our analysis also indicated that physical punishment style significantly mediated the association between history of inter-parental physical conflict and persistent behavioural difficulties, as the indirect effect was significant ($B = 0.01$, $SE = 0.002$, $\beta = 0.01$, $p < .05$). History of inter-parental physical conflict was also not significant in our adjusted model ($B = 0.02$, $SE = 0.01$, $\beta = 0.03$), indicating that its association with persistent difficulties was fully mediated by physical punishment parenting style.

Consistent with the results from our first multiple mediation analysis predicting the development of behavioural from 2 to 4.5 years, formal support was negatively associated with physical punishment style ($B = -0.01$, $SE = 0.002$, $\beta = -0.05$, $p < .001$), whereas informal support was positively associated with physical punishment ($B = 0.01$, $SE = 0.002$, $\beta = 0.06$, $p < .001$). Increased informal support was also predictive of a reduced likelihood of maternal depression at 4.5 years ($B = -0.002$, $SE = 0.001$, $\beta = -0.05$, $p \leq .001$).

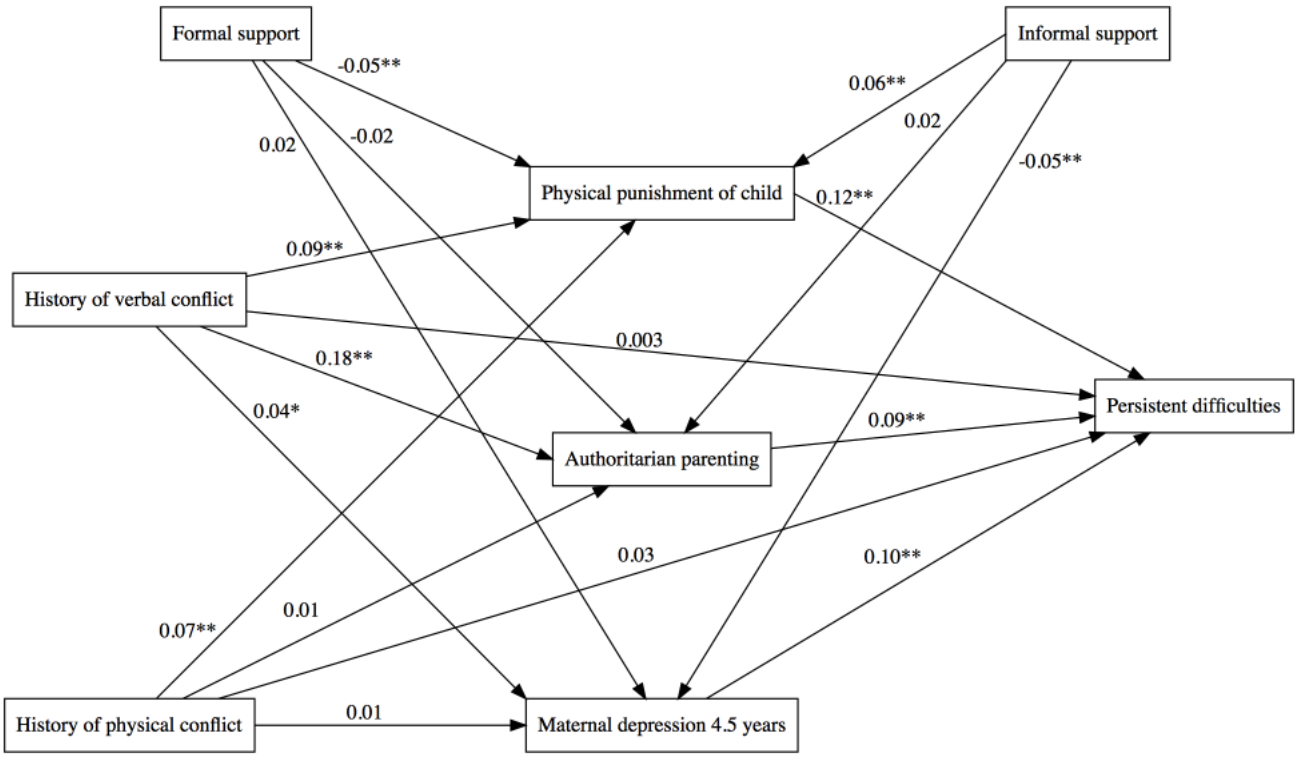

Figure 6.3. Multiple mediation model investigating predictors of persistent behavioural difficulties. Standardised coefficients are presented. Model adjusts for prenatal perceived stress, mother's age when pregnant, mother's ethnicity, area-level deprivation, child's sex and birthweight. $^{**}p \leq .001$, $^{*}p \leq .05$.

Table 6.4.
Results from the multinomial logistic regression, evaluating factors associated with persistent behavioural difficulties relative to other behavioural stability groups.

	No difficulties vs Persistent difficulties				Improved vs Persistent difficulties				Later difficulties vs Persistent difficulties			
	B (SE)	OR (95% CI)	Inverse OR (95% CI)	z-value	*B* (SE)	OR (95% CI)	Inverse OR (95% CI)	z-value	*B* (SE)	OR (95% CI)	Inverse OR (95% CI)	z-value
Prenatal perceived stress	-0.05	0.95	1.05	-2.89*	0.003	1.00	1.00	0.15	-0.05	0.95	1.05	-2.36*
	(0.02)	(0.92, 0.98)	(1.02, 1.09)		(0.02)	(0.96, 1.05)	(0.96, 1.04)		(0.02)	(0.92, 0.99)	(1.01, 1.09)	
Prenatal depression												
Not depressed												
Depressed	0.01	1.01	0.99	0.05	0.05	1.05	0.95	0.16	0.001	1.00	1.00	0.003
	(0.27)	(0.60, 1.71)	(0.59, 1.66)		(0.31)	(0.57, 1.95)	(0.51, 1.76)		(0.30)	(0.56, 1.80)	(0.55, 1.80)	
Postnatal anxiety												
Minimal to mild												
Moderate to severe	0.13	0.88	1.14	-0.38	0.48	1.62	0.62	1.22	0.37	1.45	0.69	0.99
	(0.35)	(0.45, 1.72)	(0.58, 2.25)		(0.40)	(0.75, 3.53)	(0.28, 1.34)		(0.38)	(0.70, 3.03)	(0.33, 1.44)	
Postnatal depression												
Not depressed												
Depressed	-0.09	0.91	1.10	-0.28	-0.50	0.60	1.66	-1.26	-0.11	0.90	1.11	-0.29
	(0.33)	(0.47, 1.75)	(0.57, 2.11)		(0.40)	(0.28, 1.32)	(0.76, 3.63)		(0.37)	(0.44, 1.86)	(0.54, 2.30)	
Maternal evaluation	-0.001	1.00	1.00	-0.03	-0.06	0.94	1.06	-2.27*	-0.01	0.99	1.01	-0.43
	(0.02)	(0.96, 1.04)	(0.96, 1.05)		(0.03)	(0.90, 0.99)	(1.01, 1.12)		(0.03)	(0.94, 1.04)	(0.96, 1.06)	
Informal support	0.002	1.00	1.00	0.09	-0.03	0.97	1.03	-1.21	-0.01	0.99	1.01	-0.45
	(0.02)	(0.97, 1.04)	(0.96, 1.03)		(0.02)	(0.93, 1.02)	(0.98, 1.07)		(0.02)	(0.95, 1.03)	(0.97, 1.05)	
Formal support	0.02	1.02	0.98	0.91	0.04	1.04	0.97	1.38	0.03	1.03	0.97	1.16
	(0.02)	(0.98, 1.06)	(0.94, 1.02)		(0.03)	(0.99, 1.09)	(0.92, 1.02)		(0.02)	(0.98, 1.08)	(0.93, 1.02)	
History of verbal conflict												
No												
Yes	-0.15	0.86	1.16	-0.67	-0.28	0.75	1.33	-1.05	-0.07	0.93	1.08	-0.28
	(0.22)	(0.55, 1.33)	(0.75, 1.80)		(0.27)	(0.44, 1.28)	(0.78, 2.25)		(0.25)	(0.57, 1.52)	(0.66,1.77)	
History of physical conflict												
No												
Yes	-0.28	0.76	1.32	-1.12	0.10	1.11	0.90	0.35	-0.10	0.90	1.11	-0.36
	(0.25)	(0.47, 1.23)	(0.81, 2.14)		(0.29)	(0.62, 1.98)	(0.51, 1.61)		(0.28)	(0.53, 1.55)	(0.64, 1.90)	

Table 6.4 Continued.

	No difficulties vs Persistent difficulties				Improved vs Persistent difficulties				Later difficulties vs Persistent difficulties			
	B (SE)	OR (95% CI)	Inverse OR (95% CI)	z-value	*B* (SE)	OR (95% CI)	Inverse OR (95% CI)	z-value	*B* (SE)	OR (95% CI)	Inverse OR (95% CI)	z-value
Authoritative parenting	0.23 (0.22)	1.25 (0.82, 1.93)	0.80 (0.52, 1.23)	1.03	0.18 (0.26)	1.19 (0.71, 2.00)	0.84 (0.50, 1.40)	0.67	0.002 (0.24)	1.00 (0.62, 1.62)	1.00 (0.62, 1.61)	0.01
Physical punishment style	-0.47 (0.15)	0.62 (0.47, 0.83)	1.60 (2.14, 1.20)	-3.20**	-0.25 (0.18)	0.78 (0.55, 1.11)	1.28 (0.90, 1.82)	-1.37	0.05 (0.16)	1.05 (0.76, 1.44)	0.95 (0.69, 1.31)	0.28
Authoritarian parenting	-0.76 (0.15)	0.47 (0.34, 0.63)	2.15 (1.59, 2.90)	-4.96**	-0.32 (0.18)	0.73 (0.51, 1.04)	1.37 (0.96, 1.97)	-1.72	-0.25 (0.17)	0.78 (0.55, 1.08)	1.29 (0.92, 1.80)	-1.49
Maternal depression at 4.5 years												
Not depressed												
Depressed	-0.80 (0.25)	0.45 (0.27, 0.73)	2.23 (1.36, 3.66)	-3.19**	-0.36 (0.30)	0.70 (0.38, 1.27)	1.43 (0.79, 2.60)	-1.18	0.30 (0.27)	1.35 (0.80, 2.29)	0.74 (0.44, 1.25)	1.12

Note: $^{**}p \leq .001$, $^{*}p \leq .05$.

Analysis controlled for mother's ethnicity, education, and age when pregnant, parity, planned pregnancy, area-level deprivation, exclusive breastfeeding duration, and child's sex, birthweight and gestational age. See Table A2 for multinomial logistic regression results relating to control variables.

6.6. Discussion

This study investigated factors associated with the development, persistence, and change in behavioural difficulties during early childhood. Taken together, the results provide evidence that maternal mental health, parenting styles, inter-parental conflict, maternal self-evaluation and means of social support impacted the likelihood that children will develop behavioural difficulties from 2 to 4.5 year, as well as whether behavioural difficulties persisted or improved over this period.

In terms of maternal mental health, children whose mothers had moderate to severe postnatal anxiety had an increased likelihood of developing behavioural problems from 2 to 4.5 years, relative to children whose mothers experienced minimal to mild postnatal anxiety. On the other hand, children of mothers who experienced greater prenatal stress had an increased likelihood of showing persistent behavioural difficulties. Further, children of mothers who experienced depression at 4.5 years had an increased likelihood of developing later behavioural difficulties and showing persistent difficulties. These results are consistent with other studies that have linked maternal mental health to the development of behavioural difficulties (Glasheen et al., 2010; S. H. Goodman et al., 2011; Huizink et al., 2003) as well as persistent behavioural difficulties in children (Galéra et al., 2011; Mathiesen & Sanson, 2000). Our findings also suggest that there may be a prenatal influence of maternal mental health for children with persistent behavioural difficulties. However, our results are in contrast to the study by Huang et al. (2010); while they found that maternal mental health mediated the association between domestic violence and behavioural problems, our results showed no significant mediating effect of maternal mental health at 4.5 years.

We found that maternal parenting styles were linked to the development of later behavioural difficulties at 4.5 years, as well as the persistence of difficulties from 2 to 4.5 years. Specifically, greater authoritarian and physical punishment parenting style scores were associated with an increased likelihood of developing later difficulties and showing persistent difficulties. Furthermore, both these parenting styles mediated the association between a history of verbal inter-parental conflict and the later development and persistence of behavioural difficulties in children.

Only physical punishment parenting style mediated the association between a history of physical inter-parental conflict and the later development and persistence of behavioural difficulties in children. Our results are consistent with that of Huang et al. (2010), who found that parenting style and spanking mediated the association between earlier domestic violence exposure and subsequent behavioural problems at age 5. Our study extends current research (C.-C. Huang et al., 2010; Levendosky et al., 2006) to show that authoritarian and physical punishment parenting styles mediate the effects of inter-parental conflict (verbal and physical) on later development *and* persistence of behavioural problems. Our results showing that negative parenting styles are associated with early development of behavioural difficulties are consistent with previous research (Alizadeh et al., 2011; MacKenzie et al., 2012; C. A. Taylor et al., 2010). Further, our findings extend this literature to show that harsh parenting styles are also associated with the persistence of behavioural difficulties.

Previous research suggests that authoritative parenting is associated with fewer behavioural problems in primary school-age children (Alizadeh et al., 2011) and greater resilience in adolescents (Kritzas & Grobler, 2005). As such, one might expect that

authoritative parenting is associated with a reduced likelihood of developing difficulties, or improved behaviour. However, we found no such effect. While this was somewhat unexpected, it does align with other work that has failed to find an association between authoritative parenting and behavioural problems in children (Akhter, Hanif, Tariq, & Atta, 2011; Braza et al., 2015). The lack of association between authoritative parenting style and improvements in children's behaviour from 2 to 4.5 years found in our study may be due to assessment timeframes. We assessed authoritative parenting style only at 4.5 years. Although not ideal, a large amount of information is gathered at each DCW; therefore, omitting some measures at certain waves results in a less arduous and time-consuming experience for the study participants. In future research, we will have a measure of parenting styles at multiple time points, so that we can elucidate whether a change in authoritative parenting style score is associated with improvements in child behaviour.

Although we found that negative parenting styles were associated with behavioural difficulties in children, our descriptive results indicate that mothers generally endorsed these parenting methods only occasionally. At the same time, our findings indicate avenues that might lessen the need to resort to negative parenting styles. Importantly, we found that means of social support were associated with both physical punishment parenting style and maternal mental health. Greater support from formal or external means, such as healthcare professionals, support programmes, and support resources (e.g. books, websites), was associated with a reduced endorsement of a physical punishment parenting style. Unexpectedly, greater informal support (friends and family) was associated with greater endorsement of a physical punishment parenting style.

Although it is unclear why this association exists, one possibility is that this group of participants may have had more exposure to friends and family that endorse harsh methods of parenting. We encourage further investigation into the reasons for this relationship. On the other hand, greater informal means of maternal support was associated with a reduced likelihood of maternal depression at 4.5 years. The association of social support with positive outcomes, such as a lower endorsement of a physical punishment parenting style and greater maternal mental health, is consistent with work by Armstrong, Birnie-Lefcovitch and Ungar (2005) and Black and Lobo (2008) in showing that greater social support available to the family is associated with increased family resilience.

In terms of factors that distinguished children who improved their behaviour from 2 to 4.5 years from those whose behavioural difficulties persisted, only maternal parenting self-evaluation was significant. Children of mothers that had a higher evaluation of themselves as a parent showed a reduced likelihood of improving their behaviour. This finding is contrary to what we have previously found in a study evaluating behavioral difficulties in children aged 2 years, where greater maternal self-evaluation was associated with a reduced likelihood of showing behavioural difficulties (D'Souza, Waldie, et al., in press). However, our measure of parenting self-evaluation used items relating to how well the mother believes they know their child and the extent to which their parental expectations are being met; as such, mothers higher in parental self-evaluation may feel like they do not need to change their parenting behaviour because their expectations of themselves as a parent are being met and they feel that they know their child well. Therefore, while maternal self-evaluation may be protective

against the development of difficulties, in instances where children already show difficulties, mothers with a greater self-evaluation may be less likely to change their behaviour. Consequently, this may contribute to ongoing behavioural problems in the child. Future research could explore this possibility.

Our findings have practical implications for improving parenting style, maternal mental health and child behaviour. Our results suggest that greater use of formal and external support systems may be an important means for parents. Particularly, mothers with a history of verbal and physical conflict with their partner may benefit from this support, as their experience of conflict may contribute to the use of harsh parenting techniques (Erel & Burman, 1995; Krishnakumar & Buehler, 2000). The results also suggest that it is imperative to address maternal prenatal stress and postnatal anxiety. Our findings indicate that boosting informal support structures through greater contact with friends and family, or assisting in access to community or group-based parental support services, would decrease the likelihood of maternal depression when children were 4.5 years. Overall, our findings indicate that efforts to improve serious behavioural problems in children would benefit from using a broader, family-centred approach.

A limitation of the current study was a sole focus on maternal mental health and parenting behaviour, without addressing the role of the father. There is evidence that fathers' parenting style may moderate the effect of mothers' parenting behaviour (Braza et al., 2015). At the DCW when mothers were asked about parenting styles, partners were not interviewed about their parenting style. We encourage further research into whether maternal and paternal parenting behaviours contribute to the development and persistence of early childhood behavioural problems. In particular, future studies could evaluate the

role of the father, and how that may affect the persistence and change in behavioural problems.

It is also important to note that within our multiple mediation analyses, standardised beta weights for significant associations were generally relatively small in size. This suggests that factors such as maternal depression and parenting styles may have small effects on child behaviour. However, harsh parenting styles and poor maternal mental health likely co-occur (Gershoff, 2002; Smith, 2004), particularly in conjunction with other risk factors for behaviour problems such as high socioeconomic deprivation and young maternal age. Therefore, while individual effect sizes for risk factors may be small, these associations were significant and likely to be cumulative in nature.

The current study has a number of strengths. Notably, the large, population-based sample allowed us to test multiple mediation effects, and focus on more clinically significant groups rather than continuous measures. The multidisciplinary nature of the *Growing Up in New Zealand* study also meant that we could consider the influence of a range of variables on behavioural problems in early childhood, while effectively controlling for sociodemographic factors. Further, to our knowledge, this is the first study to evaluate factors beyond maternal mental health that may contribute to the persistence and change in early childhood behavioural difficulties.

Overall, the current study showed that maternal mental health and negative parenting styles were associated with an increased likelihood of children developing behavioural difficulties at 4.5 years and showing persistent difficulties from 2 to 4.5 years. Authoritarian and physical punishment parenting styles mediated the association between a history of verbal inter-parental conflict and the development of later

behavioural difficulties and persistent difficulties, whereas only physical punishment parenting style mediated the association between a history of physical inter-parental conflict and behavioural difficulties. We found no effect of authoritative parenting in any of our analyses. That is not to say that parenting programmes for parents of children with behavioural problems should not focus on developing authoritative parenting techniques, but that parents may also benefit more from learning to reduce harsh parenting techniques. The only factor that distinguished children who improved their behaviour from those whose behavioural difficulties persisted was maternal self-evaluation at 9 months, with mothers who had a greater parenting self-evaluation being more likely to have children who persisted than improved.

Notably, our findings highlight the importance of considering the whole family unit when addressing children with behavioural difficulties. The results highlight that increasing formal and informal support services may offer important avenues for improving parenting style and maternal mental health respectively, which in turn may positively influence child behaviour.

7. General Discussion

The long-term, adverse physical, cognitive, and psychosocial outcomes associated with childhood behavioural problems are well reported (Fergusson et al., 2005; Jakobsen, Fergusson, et al., 2012; Jakobsen, Horwood, et al., 2012; McGee et al., 2002; Mistry et al., 2017; Poulou, 2013). In addition, there is increasing evidence that early childhood may be an important period to target for the prevention of these outcomes (Nelson et al., 2003; Poulou, 2013). However, there is some evidence that behavioural problems in early childhood may not be stable (Mathiesen & Sanson, 2000). Investigating the factors that contribute to the development, persistence and change in these early childhood behavioural problems may be important in informing policy and initiatives that promote positive development in children.

Bronfenbrenner's (1979) bioecological model highlights the importance of considering the multiple environmental or ecological systems that a child is embedded within when identifying potential factors that may influence children's development. These systems include the child's immediate environment (microsystem), interactions between factors in the immediate environment (mesosystem), the indirect environment (exosystem), the broader sociocultural context (exosystem) and finally, life course transitions and the sociohistorical context (chronosystem). During the early childhood period, the child's macrosystem, and consequently their micro-, meso- and exosystems, relate primarily to the child's immediate family (Nau & Heckert, 2013). As such, considering the family context is key when investigating the factors contributing to early childhood behavioural problems.

Therefore, the primary aim of this thesis was to investigate early childhood behavioural problems and familial factors associated with its development within a population-based New Zealand birth cohort. As efforts to improve children's behaviour need to also consider whether the child may show difficulties in other domains, we investigated whether children with behavioural problems were also at an increased risk of showing preschool cognitive difficulties.

In the following sections, the six studies that make up this thesis will be summarised, and emphasis will be placed on the novelty of the findings and the hypotheses that were supported or not supported. The thesis' theoretical framework, provided by Bronfenbrenner's (1979) bioecological model (along with the family emphasis of Nau and Heckert, 2013) will be discussed and some broad conclusions drawn. Unexpected findings within this thesis will also be addressed. Finally, the practical implications of the thesis findings will be highlighted, along with study limitations and some suggestions for future research.

7.1. Summary

The broad aim of this thesis was to investigate the development of behavioural problems during early childhood, with five research questions specifically of interest: (1) Is the SDQ a reliable and valid measure of behavioural difficulties in 2 years olds? (2) What are the predictors of behavioural difficulties in 2 year olds? (3) What is the stability in behavioural problems over the early childhood period (i.e. from 2 to 4.5 years)? (4) What are the cognitive difficulties associated with persistence and change in early childhood behavioural problems? (5) What are the predictors of persistence and change in early childhood behavioural difficulties? In the section that follows, the studies within the

thesis that address these five research questions will be summarised, and conclusions based on their findings are drawn.

7.1.1. Is the SDQ a reliable and valid measure of behavioural difficulties in 2 year olds?

This thesis used data from the *Growing Up in New Zealand* study to investigate the development of behavioural problems during early childhood. Behavioural problems were assessed within the cohort when study members were aged 2 and 4.5 years, using the parent-rated SDQ. The use of the SDQ at the study's 2 year DCW was novel, as there was no published evidence on whether the questionnaire was a reliable and valid measure of behaviour in children under the age of 3 years. Therefore, the first research question this thesis hoped to address was whether the SDQ was an acceptable measure of behavioural problems in 2 year old children. To investigate this, Study 1 firstly assessed the mother-rated SDQ's structural validity. We tested Goodman's (1997) original five-factor model, as well as a modified model based on the work by Van de Looij-Jansen et al. (2011) that adjusted for a possible positive construal method effect. We hypothesised that we would find superior model fit for the modified model compared to the original model. Consistent with our hypothesis, we found improved and acceptable model fit indices for the modified model. Our results did not show satisfactory model fit for the original five-factor model. The findings imply that the positively-worded items in the SDQ are reflecting a positive construal response style.

Subsequently, we evaluated measurement invariance of the modified model across child's gender, area-level deprivation and mother's ethnicity, to ensure that the factor structure remained valid across different sociodemographic groups and therefore

group comparisons could be made. We found full measurement (configural, metric and scalar) invariance across gender and deprivation, and full configural and metric invariance across mother's ethnicity. We only obtained partial invariance across mother's ethnicity, due to the threshold for one item ('tempers') from the conduct problems subscale showing non-invariance; however, as the remaining four items on the subscale showed scalar invariance, valid comparisons of the SDQ can still be made across ethnic groups (Steenkamp & Baumgartner, 1998).

Study 2 also compared the original and modified models in a subsample of the cohort who had father-rated SDQ data. Consistent with Study 1, poor model fit was found for the original five-factor model, with improved and acceptable fit obtained for the modified model. We also found full measurement invariance of the modified model across mothers and fathers. This indicates that mothers and fathers are interpreting the SDQ in the same way, and the same underlying constructs are being measured across both parents. In addition, to evaluate inter-rater reliability, agreement between mother-rated and father-rated continuous SDQ scores were assessed and moderate correlations were found for all measures.

Both Studies 1 and 2 evaluated the internal consistency reliability of the mother- and father-rated SDQ, respectively, using Cronbach's alpha and MIC coefficients. We hypothesised that we would find generally acceptable internal consistency for SDQ measures, but low alpha coefficients for peer problems. Consistent with our hypothesis, acceptable alpha coefficients were found for all mother- and father-rated SDQ measures, except peer problems. In addition, while mother-rated peer problems obtained a satisfactory MIC value, this value was low for father-rated peer problems. These results

suggest that the peer problems subscale shows generally poor internal consistency within our sample. MIC coefficients were satisfactory for all other SDQ measures.

Overall, Studies 1 and 2 indicated that the parent-rated preschool SDQ showed generally acceptable psychometric properties when accounting a positive construal factor. Therefore, the preschool SDQ can be used in 2 year olds, though caution must be taken when using and interpreting the original prosocial and peer problems subscales. Study 1 also determined cut-offs to indicate normal, borderline, and abnormal bands for each SDQ measure, with the abnormal band indicative of children with likely clinically significant behavioural problems (R. Goodman, Ford, et al., 2000; R. Goodman, Renfrew, et al., 2000).

7.1.2. What are the predictors of behavioural difficulties at 2 years?

In Study 3, we were interested in identifying prenatal and postnatal risk and protective factors specific to the mother and family that were associated with serious behavioural difficulties (i.e. scoring within the abnormal range for each SDQ difficulties measure) at age 2. We hypothesised that teratogen exposure, inadequate folate intake, and reduced breastfeeding would be associated with an increased likelihood of showing behavioural problems. We also hypothesised that poorer prenatal and postnatal maternal mental health as well as greater inter-parental conflict (physical and verbal) would be associated with an increased risk of behavioural problems. Finally, we hypothesised that greater social support available to the family as well as higher maternal parenting self-evaluation would be protective against the development of age 2 behavioural problems.

We found that risk factors associated with serious emotional symptoms included greater prenatal perceived stress in the mother, lack of folate supplements during

pregnancy, and moderate to severe postnatal anxiety. Factors associated with an increased risk of serious peer problems included breastfeeding for less than 6 months and informal support. Risk factors associated with hyperactivity-inattention problems included greater maternal perceived stress during pregnancy, mothers' prenatal exposure to second hand smoke, moderate to severe postnatal anxiety, and low maternal parenting self-evaluation. Factors associated with an increased likelihood of conduct problems and serious total difficulties were greater prenatal perceived stress, verbal inter-parental conflict, and low maternal parenting self-evaluation. Exclusive breastfeeding for less than 6 months, relative to 6 months or more, was also associated with an increased likelihood of serious total difficulties.

Overall, the findings from Study 3 indicate that there are several prenatal and postnatal risk and protective factors associated with *multiple* behavioural outcomes. Specific risk factors associated with multiple behavioural outcomes included prenatal perceived stress and moderate to severe postnatal anxiety in the mother, as well as verbal inter-parental conflict. Protective factors associated with multiple behavioural outcomes included greater exclusive breastfeeding duration, and maternal parenting self-evaluation. These findings support some of our initial hypotheses. Unexpectedly, physical inter-parental conflict was not associated with behavioural outcomes at age 2. However, we also expected that not all predictors would remain significant in our multivariable model, due to the large number of variables accounted for. Furthermore, it is possible that the association between physical inter-parental conflict and child behavioural problems was due to another mediating variable included (or not included) in the multivariable model.

7.1.3. What is the stability in behavioural problems over the early childhood period?

Study 4 investigated the persistence and change in serious behavioural difficulties from 2 to 4.5 years. For each SDQ difficulties measure, raw scores at 2 years and 4.5 years were moderately correlated. Based on previous research by Mathieson and Sanson (2000), we hypothesised that while some children would persist in behavioural difficulties from 2 to 4.5 years, a considerable proportion would improve over this period. Consistent with this hypothesis, we found that, for each measure, a considerable proportion of children who showed serious behavioural difficulties at age 2 persisted in these difficulties at 4.5 years (42.1% for total difficulties), but the majority of children who showed abnormal scores at 2 years improved at 4.5 years (57.9% for total difficulties). Furthermore, a small percentage of children who did not show behavioural difficulties at 2 years showed a later onset of behavioural problems by scoring within the abnormal range at 4.5 years (8% for total difficulties).

Our investigation into the sociodemographic factors characterising the different behavioural development profiles indicated that children who showed behavioural difficulties at one or both time points has a greater proportion of children who were male, the result of an unplanned pregnancy, and lived in highly deprived and urban areas relative to children with no behavioural difficulties during early childhood. Children who showed behavioural problems during at least one time point also had a greater proportion of mothers who were younger, of Māori and Pacific ethnicity and who were less educated.

7.1.4. What are the cognitive difficulties associated with persistence and change in early childhood behavioural problems?

In Study 5, we were interested in determining whether behavioural difficulties at either 2 or 4.5 years as well as persistent difficulties over this period were associated with an increased likelihood of cognitive delay at 4.5 years. We hypothesised that children with at least a single instance of behavioural problems would show an increased risk of cognitive difficulties relative to children with no behavioural problems. Overall, the results were generally consistent with our hypothesis.

We found that children who showed behavioural difficulties only at 4.5 years (i.e. concurrent difficulties) and children with persistent difficulties had an increased risk of cognitive delay. Specifically, relative to children with no early childhood behavioural difficulties, children who only showed behavioural difficulties at 4.5 years were more likely to show delays in receptive language and executive control, whereas children with persistent difficulties were more likely to show delays in early literacy ability and executive control. Children who showed serious behavioural problems at 2 years but improved at 4.5 years did not have an increased risk of cognitive delay when assessing each cognitive measure individually; however, relative to children with no behavioural difficulties, those with who improved still had an increased risk of showing a single delay across the three cognitive measures. Furthermore, children with concurrent and persistent behavioural difficulties were more likely to show comorbid delays across the three cognitive measures when compared to children with no behavioural difficulties.

7.1.5. What are the predictors of persistence and change in early childhood behavioural difficulties?

The final study of this thesis investigated factors associated with the persistence and change in behavioural difficulties from 2 to 4.5 years. Similar to Study 3, Study 6 also focused on risk and protective factors specific to the mother and family, specifically maternal mental health, parenting behaviour, social support, and inter-parental conflict. In contrast to Study 3, rather than solely investigating significant predictors, this study tried to address potential mediating effects and elucidate pathways that lead to the development and persistence of early childhood behavioural difficulties. We hypothesised that poorer maternal mental health at each relevant time point would be associated with persistent behavioural problems, whereas poorer maternal mental health at 4.5 years would be associated with the development of behavioural difficulties from 2 to 4.5 years. We also hypothesised that an authoritative parenting style would be associated with an improvement in behavioural problems from 2 to 4.5 years. Finally, we also expected that poor maternal mental health and harsh parenting styles would mediate an association between inter-parental conflict (physical and verbal) and behavioural problems.

We found that children whose mothers had moderate to severe postnatal anxiety were more likely to develop behavioural problems from 2 to 4.5 years, relative to children whose mothers showed minimal to mild anxiety. In contrast, greater perceived prenatal stress in the mother was associated with an increased likelihood of the child showing persistent behavioural difficulties during early childhood. Furthermore, children of mothers who experienced depression at 4.5 years had an increased likelihood of both

developing difficulties at 4.5 years and showing persistent difficulties from 2 to 4.5 years. The association between poor maternal mental health and early childhood behavioural problems was generally consistent with our hypothesis.

The study also found that greater authoritarian and physical punishment parenting styles were associated with an increased risk of the child developing both behavioural difficulties at 4.5 years and showing persistent difficulties from 2 to 4.5 years. In addition, both parenting styles mediated the association between a history of inter-parental verbal conflict and the later development and persistence of early childhood behavioural problems. Only physical punishment parenting style mediated the association between a history of inter-parental physical punishment and the later development and persistence of behavioural difficulties. This is consistent with our hypothesis that harsh parenting behaviour would mediate the association between inter-parental conflict and behavioural problems in children. However, we did not find evidence to support the hypothesis that poor maternal mental health would also mediate the association between exposure to inter-parental conflict and behavioural problems in children. Our results further indicated that greater formal (external) support was associated with reduced endorsement of a physical punishment parenting style, and greater informal (friends and family) support was associated with a reduced likelihood of maternal depression at 4.5 years.

In contrast to our expectation that authoritative parenting would be associated with an improvement in behavioural difficulties from 2 to 4.5 years, the only factor that distinguished children who improved from children who persisted was maternal parenting self-evaluation at 9 months. Specifically, mothers who had a greater self-evaluation of

their parenting were more likely to have children who persisted in their behavioural difficulties than improved.

7.2. The SDQ as a measure of behavioural problems in early childhood

As previously noted, the SDQ has several advantages that make it ideal for measuring behaviour in large scale longitudinal studies such as *Growing Up in New Zealand*. These include its brevity, free accessibility, and ability to identify clinical cases (R. Goodman, Ford, et al., 2000; R. Goodman, Renfrew, et al., 2000; R. Goodman & Scott, 1999). It has also shown generally acceptable psychometric properties in children and adolescents of varying ages and from different populations (Becker, Woerner, Hasselhorn, Banaschewski, & Rothenberger, 2004; Croft, Stride, Maughan, & Rowe, 2015; Doi et al., 2014; Ezpeleta, Granero, la Osa, Penelo, & Domènech, 2013; R. Goodman, 2001; Hawes & Dadds, 2004; He, Burstein, Schmitz, & Merikangas, 2013; Hill & Hughes, 2007; Klein, Otto, Fuchs, Zenger, & von Klitzing, 2013; Matsuishi et al., 2008; Theunissen et al., 2013; Van Leeuwen et al., 2006; Van Roy, Veenstra, & Clench-Aas, 2008; Woerner et al., 2004). However, in spite of its use in children under the age of 3 years (e.g., Sim et al., 2013), the instrument was yet to be validated in children below this age. Overall, research into the psychometric properties of the preschool SDQ was generally limited.

While our results from both Studies 1 and 2 did not support the original five-factor model proposed by Goodman (1997), our findings are consistent with the few studies that have accounted for a positive construal method effect (van de Looij-Jansen et al., 2011; Van Roy et al., 2008). Similar to van de Looij-Jansen et al. and Van Roy et al., we found superior model fit when accounting for a positive construal response style,

relative to the original five-factor model. We found generally acceptable internal consistency estimates for all parent-rated SDQ subscale, except for peer problems. However, the low alpha coefficients for peer problems were expected, as this has been found in previous studies (Doi et al., 2014; Du et al., 2008; R. Goodman, 2001; Hawes & Dadds, 2004; Matsuishi et al., 2008; Theunissen et al., 2013; Van Leeuwen et al., 2006; Woerner et al., 2004).

Study 2 also addressed SDQ measurement invariance and agreement across parents. Studies that use parent-rated SDQ scores from an unspecified parent or compare scores from both parents (Davé et al., 2008; Griffith et al., 2014; Mellor et al., 2011) are assuming that measurement invariance of the SDQ factor structure across mothers and fathers. However, to our knowledge, only one study has investigated measurement invariance across parents, using the standard SDQ (Chiorri et al., 2016). Our study supported the findings by Chiorri et al. in showing measurement invariance of the preschool SDQ across mothers and fathers.

We also found moderate correlations between mothers' and fathers' SDQ ratings. This is somewhat consistent with previous research (Borg et al., 2012; Davé et al., 2008; Griffith et al., 2014; Mellor et al., 2011), though these studies have found moderate to large correlations between parents' ratings rather than just moderate correlations. However, one reason for not observing large correlations for any of the SDQ measures in our study could be due to the young age of our participants. Previous research has typically assessed inter-parental agreement on the SDQ in older children, and there is evidence that agreement between parents on measures gets stronger as children get older (Duhig et al., 2000).

Over and above our support of previous research within this domain, Studies 1 and 2 also make important contributions to SDQ literature. These studies not only add to limited research on the preschool version of the SDQ and agreement between parents, it was also novel in its evaluation of the possibility of a positive construal method effect using the preschool SDQ. Furthermore, Study 1 was the first study to evaluate the psychometric properties of the preschool SDQ in 2 year old children, and to determine normative scores and bandings for SDQ categorisation within a NZ population. An added strength with this research was that it established satisfactory measurement invariance of the modified factor structure across child's gender, mother's ethnicity, area-level deprivation, and parents. Overall, although our results support the presence of a positive construal method effect, they do suggest that the difficulties measures, with the possible exception of peer problems, are appropriate for assessing behavioural difficulties in 2 year olds.

7.3. Determinants of the development and persistence in early childhood behavioural problems[3]

The results from Study 1 indicated that we could measure early childhood behavioural problems at 2 years; however, the results from Study 4 suggested that behavioural problems were not stable from 2 to 4.5 years. Therefore, guided by

[3] While Study 3 investigated the predictors of all difficulties measures at age 2, Study 6 only investigated determinants of the persistence and change of total behavioural difficulties. As such, this section will also focus primarily on the factors associated with just total behavioural problems at age 2 to provide a more consistent and coherent discussion.

Bronfenbrenner's (1979) bioecological model, and Nau and Heckert's (2013) discussion of the importance of family context in shaping children's health and wellbeing, Studies 3 and 6 focused on factors associated with the mother and family to investigate the predictors of the development and persistence in early childhood behavioural problems. Adjusting for the child's macrosystem (i.e. their sociocultural context) and some individual measures (e.g. sex, birthweight, gestational age), several factors relating to the child's micro-, meso-, and exosystems were identified as significant predictors of early childhood behavioural problems in Studies 3 and 6; these are displayed in Figure 7.1, along with some of the factors controlled for in analyses.

The findings from this thesis indicated that maternal mental health at multiple time points was associated with early childhood behavioural problems. Maternal perceived stress during pregnancy was the only prenatal factor associated with total behavioural problems in early childhood (though Study 3 did identify other prenatal factors associated with emotional symptoms and hyperactivity-inattention). Specifically, Studies 3 and 6 showed that greater prenatal stress was linked to an increased risk of problems at age 2 for multiple SDQ outcomes, as well as persistent total behavioural problems from ages 2 to 4.5 years. These results are consistent with several studies that have shown the negative physical, cognitive and psychosocial outcomes associated with prenatal maternal stress (Beydoun & Saftlas, 2008; Charil et al., 2010; D'Souza et al., 2016; Lamb et al., 2014; Slykerman et al., 2015). They also suggest that there may be a prenatal influence of maternal mental health on persistent behavioural difficulties.

Additionally, Studies 3 and 6 showed that moderate to severe postnatal stress in the mother was associated with an increased risk of developing behavioural problems at 2 years and at 4.5 years, respectively. Study 6 also indicated that maternal depression when the child was 4.5 years was associated with an increased likelihood of showing behavioural problems at 4.5 years, as well as developing persistent behavioural difficulties from 2 to 4.5 years. These results add to the considerable literature linking maternal mental health to the development of behavioural difficulties (Glasheen et al., 2010; S. H. Goodman et al., 2011; Huizink et al., 2003), while also indicating that

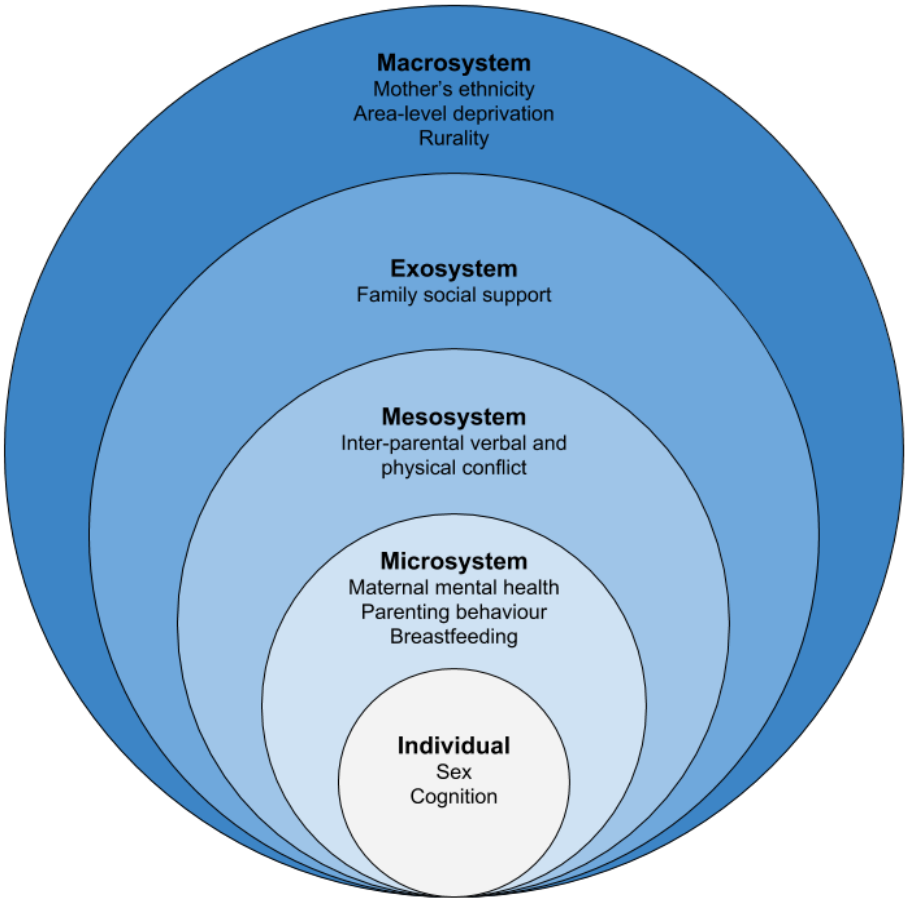

Figure 7.1. Indication of where key determinants of early childhood behavioural difficulties fit within the ecological systems corresponding to Bronfenbrenner's (1979) bioecological model.

maternal mental health may contribute to the stability of early childhood behavioural difficulties.

Other factors within the child's microsystem that were related to early childhood behavioural difficulties included parenting behaviours. Study 3 indicated that children whose mothers had a greater evaluation of themselves as a parent had a reduced likelihood of showing behavioural difficulties at 2 years. However, we also found that greater maternal parenting self-evaluation was associated with a reduced likelihood of improvement in children's behavioural difficulties form 2 to 4.5 years. This suggests that while maternal parenting self-evaluation may be protective against the development of difficulties, in children who already show behavioural difficulties, greater maternal parenting self-evaluation may be a risk factor for ongoing behaviour problems. This may be because mothers higher in parenting self-evaluation may feel like their expectations of themselves a parent are being met, and they do not need to change their behaviour. However, a change in parenting behaviour may be necessary for children who already show behavioural problems.

Our results from Study 6 regarding parenting styles also support this idea. Specifically, Study 6 demonstrated that greater endorsement of physical punishment and authoritarian parenting styles were associated with an increased risk of developing behavioural problems at 4.5 years and showing persistent behavioural difficulties from 2 to 4.5 years. These results are consistent with previous studies that have shown that harsh parenting styles are associated with behavioural problems in children (Alizadeh et al., 2011; MacKenzie et al., 2012; C. A. Taylor et al., 2010). This thesis also adds to this literature by demonstrating that negative parenting styles are not only associated with the

development of behavioural difficulties, but persistence in behavioural difficulties as well.

We also showed that both authoritarian and physical punishment parenting styles mediated the association between a history of verbal inter-parental conflict and the development of behavioural problems at 4.5 years, as well as the persistence in early childhood behavioural problems. In addition, only physical punishment parenting style mediated the association between a history of inter-parental conflict and the later development (i.e. at 4.5 years) and persistence of behavioural difficulties. These results are consistent with the spillover hypothesis, which postulates that conflict within the inter-parental relationship can 'spillover' and negatively affect the parent-child relationship (Erel & Burman, 1995; Krishnakumar & Buehler, 2000). While several studies have demonstrated that harsh parenting mediates the association between inter-parental physical conflict and child behavioural problems (C.-C. Huang et al., 2010; Levendosky et al., 2006), Study 6 extends on this literature by showing that harsh parenting also mediates an association between inter-parental verbal conflict and behavioural difficulties in children. It should be noted that inter-parental verbal conflict, though not physical conflict, was associated with an increased likelihood of behavioural problems at 2 years in Study 3. However, we did not assess parenting styles until the 4.5 year DCW, and were therefore unable to investigate mediation effects when predicting age 2 behavioural problems.

Within the child's exosystem, the results indicate that social support available to the family can influence children's behavioural development by positively influencing maternal mental health and parenting behaviours. Specifically, Study 6 showed that

greater informal support from friends and family was associated with reduced maternal depression at 4.5 years, while greater formal support from external sources (e.g. health care professionals, support programmes, and resources) was associated with a reduced endorsement of a physical punishment parenting style. This suggests that greater means of social support may promote greater maternal resilience, which likely fosters positive behavioural development in the child (Armstrong et al., 2005; Black & Lobo, 2008).

Overall, Studies 3 and 6 account for a broad range of predictors within the family context that relate to early childhood behavioural problems. Further, the results fit well within the framework provided by Bronfenbrenner's (1979) bioecological model and, importantly, suggest that a multisystemic, family-centred approach may be best when targeting behavioural problems in children.

7.4. Behavioural difficulties in early childhood and preschool cognitive outcomes

By showing that early childhood behavioural difficulties are associated with an increased risk of delay in preschool language ability and executive control, our results from Study 5 support earlier cross-sectional research in clinical and typically developing populations (Espy et al., 2011; Gremillion & Martel, 2014; Schoemaker et al., 2013; Sim et al., 2013). However, our results extend on these studies in several ways. We demonstrated a longitudinal association between early childhood behavioural problems and preschool cognitive outcomes by showing that persistent and not just concurrent behavioural difficulties are associated with delays in language and executive control. In addition, we showed that children with concurrent and persistent behavioural difficulties have an increased risk of showing comorbid delays across the three assessed cognitive domains (i.e. receptive language, early literacy ability, and executive control); to our

knowledge, this is the first study to demonstrate this association within a preschool population.

These results are particularly salient, given the age at which we have assessed cognitive ability. These cognitive outcomes were measured when participants were 4.5 years, just prior to their commencement of primary school, and studies have demonstrated that preschool cognitive abilities are associated with later academic success (Aram & Nation, 1980; Bull et al., 2008; Clark et al., 2010; Welsh et al., 2010). As such, children within our sample identified as showing cognitive delays are at risk of poor academic outcomes once they start school. Given that Study 5 indicated that children with concurrent and persistent behavioural difficulties are at an increased risk of preschool cognitive delay, this implies that these children are in a particularly disadvantaged position for subsequent academic success.

7.5. Unexpected findings

There were several unexpected findings within the current thesis that should also be considered. While we hypothesised that the modified five-factor model tested in Studies 1 and 2 would show superior model fit relative to the original five-factor model proposed by Goodman (1997), it was unexpected that the original model did not obtain satisfactory model fit. This finding is in contrast to previous research that supported the structural validity of the original five-factor model (Becker et al., 2004; Croft et al., 2015; Ezpeleta, Granero, et al., 2013; He et al., 2013; Klein et al., 2013; Van Leeuwen et al., 2006). It is unclear exactly why our findings with the original model differs from the results of these studies, though replications of Studies 1 and 2 are encouraged to further our understanding in this area.

While there was a significant association between second hand smoke exposure and age 2 behavioural problems in Study 3, it was unexpected that there was no significant effect of maternal prenatal smoking. To our knowledge, only one other study by Downey et al. (2015) has obtained a similar finding, where there appeared to be a significant association with behaviour for second hand smoke exposure but not maternal prenatal smoking behaviour. One reason for this could be that mothers are under-reporting their own smoking behaviour due to the social stigma associated with this behaviour, but reporting on their exposure to second hand smoke more accurately. It is also possible that no significant association was found with maternal smoking as we looked at smoking behaviour (never smoked, stopped smoking, or continued smoking) rather than a quantitative measure (e.g., the number of cigarettes smoked per day). Similarly, Downey et al. also focused on smoking behaviour (i.e. smoked or did not smoke during pregnancy). To reduce these methodological concerns, Huizink and Mulder (2006) recommend obtaining a more direct measure of smoking exposure (e.g. blood nicotine levels) during pregnancy.

In our investigation of factors associated with the persistence and change in early childhood behavioural problems in Study 6, it was hypothesised that an authoritative parenting style would be associated with an improvement in behavioural problems from 2 to 4.5 years. However, no such effect was observed. It is possible that the absence of this association may be due to the assessment time frames, as parenting style was only measured at 4.5 years. It may be more informative to evaluate whether an increase in authoritative parenting is associated with an improvement in early childhood behavioural difficulties in future studies.

Another interesting finding that was not hypothesised relates to maternal mental health. Specifically, the results from Studies 3 and 6 indicated that maternal depression was not a significant predictor of child behavioural difficulties when concurrent anxiety or stress was also assessed. Specifically, both studies demonstrated that greater perceived stress during pregnancy and moderate to severe postnatal anxiety were significantly associated with early childhood behavioural difficulties, whereas there was no significant effect of prenatal or postnatal depression. While in Study 6, maternal depression at 4.5 years was significantly associated with the development of behavioural difficulties at 4.5 years as well as persistent difficulties, it would be interesting to evaluate whether this association would remain significant if maternal anxiety or stress at 4.5 years was also accounted for. However, we did not measure this at the 4.5 year DCW. There is evidence that prenatal stress or anxiety predicts child outcomes more strongly than depression, possibly as a result of programming effects from elevated cortisol levels in response to stress (Field, 2011), though further research is needed to understand why a similar pattern of results is observed when looking at postnatal maternal anxiety and depression.

7.6. Research applications

The findings from this thesis have important practical significance. The results from Studies 1 and 2 suggest that the SDQ can be used as a measure of behavioural difficulties in children as young as 2 years. The SDQ is used not only within research settings, but as an instrument for clinical screening as well (R. Goodman, Ford, et al., 2000; R. Goodman, Renfrew, et al., 2000; Ministry of Health, 2016; Youth in Mind, 2014). Within the NZ population, the SDQ is used in the nationwide preschool health and development check conducted in all 4 year old children registered with a primary health

care organisation (i.e. the B4SC). Children falling within the abnormal range on SDQ scores are generally referred on to a specialist who can help with their difficulties (Ministry of Health, 2015b). The practical implication from Studies 1 and 2 suggest that the SDQ could be used even earlier in 2 year old children, though further research is needed to evaluate its sensitivity and specificity at this age.

Study 4 further indicated that behavioural difficulties are not necessarily stable during the early childhood period. While a notable proportion of children identified as showing difficulties at age 2 persisted in their difficulties, the majority of children with abnormal behavioural difficulties at age 2 improved by 4.5 years. In addition, a small proportion of children who did not show any behavioural difficulties at 2 years developed later difficulties at 4.5 years. These results imply that repeated screening for behavioural problems is important, particularly so that children with persistent difficulties can be identified.

Results from Studies 3 and 6 indicate that addressing serious behavioural problems during early childhood should consider a multisystem, family-centred approach. Specifically, it may be worth evaluating endorsement of parenting styles, parenting self-evaluation and general wellbeing in mothers of children who show significant behavioural difficulties. Further, Study 6 suggests that family social support may be an important avenue for improving maternal mental health, parenting styles and child behaviour. Increasing means and access to formal and informal sources of support in mothers of children with serious behavioural difficulties may assist in modifying the child’s behaviour by improving maternal mental health and parenting styles.

As noted above, children who obtained abnormal SDQ scores from the B4SC are generally referred to a specialist for further assistance (Ministry of Health, 2015b). The results from Study 5 imply that these children are also likely to have multiple cognitive difficulties within the domains of receptive language, early literacy ability, and executive control. As such, the specialist services that these children are referred to need to also evaluate any cognitive difficulties that the child may have. This will be important in ensuring that these children are prepared for the demands and requirements of formal schooling.

7.7. Limitations

There are some limitations that need to be considered with the current thesis. Firstly, while Studies 1 and 2 established that the SDQ shows acceptable psychometric properties in 2 year old children, we did not validate the SDQ against another measure of behavioural difficulties or formal clinical diagnoses. Unfortunately, given the large amount of information gathered during DCWs, administering additional questionnaires to measure behaviour would have been too time-consuming. Information on formal clinical diagnoses was available from the 2 year DCW (based on ICD-10 codes), but very few children were diagnosed with any mental or behavioural disorders (i.e.ICD-10 F00-F99 codes) at this age (n = 35)[4]. Additionally, this information was not obtained at 4.5 years. As such, we were unable to effectively evaluate the SDQ's sensitivity or specificity. However, this could be addressed in future research with *Growing Up in New Zealand.*

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[4] Tables E1 and E2 in Appendix E detail the specific disorders, average raw scores and categorisation at 2 and 4.5 years, as well as the categorisation for the SDQ behavioural stability variable.

The study can obtain diagnostic information via future DCWs or by linking with NZ Ministry of Health databases to evaluate the long-term predicative validity of the preschool SDQ. This will indicate whether preschool SDQ scores are predictive of whether children are diagnosed with certain psychiatric disorders. It would also be informative to evaluate whether this risk is increased in children who show persistent early childhood behavioural difficulties, relative to children showing behavioural difficulties at a single time point.

Due to the large amount of information collected at DCWs, we were also unable to obtain a comprehensive assessment of preschool cognitive ability. This resulted in singular measures of early literacy ability, receptive language, and executive control. Our findings and conclusions would have been strengthened if we had multiple measures of a cognitive construct. To further our understanding of the association between behaviour and cognition during development, future DCWs should aim to assess a greater variety of cognitive outcomes.

An additional limitation was the missing item from the 4.5 year DCW, which corresponded to the conduct problems subscale. This occurred due to an administrative error, prior to the commencement of this thesis. As discussed in the Chapter 4 prologue, several methods were considered for addressing this missing item. It was decided that using the standard SDQ scoring method for missing values was most appropriate and parsimonious. However, when evaluating this method with the 2 year SDQ data (i.e. comparing score with the missing item, and pro-rated scores without the missing item), significant differences were observed in mean scores and the categorisation of scores. Nevertheless, the total difficulties measure appeared to be less impacted by the missing

item than conduct problems, as there was a much lower Cronbach's alpha coefficient observed for the 4.5 year conduct problems.

Given that our evaluation of the SDQ psychometric properties indicated potential methodological issues with the prosocial and peer problems subscales, and conduct problems at 4.5 years appeared to be notably impacted by the missing item, it was decided that any analyses using the 4.5 year SDQ (i.e. Studies 5 and 6) would focus solely on total difficulties. Unfortunately, this meant that we could only evaluate associations with the persistence and change in broad early childhood behavioural problems, and could not look at more nuanced aspects of behavioural difficulties. Furthermore, although the differences in mean scores and categorisations appeared to be small for total difficulties when using the pro-rata method for addressing the missing item, these differences were still significant. As such, replication of the results from Studies 4 to 6 should be conducted with SDQ data obtained in future DCWs.

The current thesis was also somewhat limited in its investigation of persistence and change in childhood behavioural difficulties, as we could only track the stability in behavioural problems over two DCWs. As such, change across two time points may also be due to measurement error, rather than true change. However, *Growing Up in New Zealand* is currently collecting data for its 8 year DCW, which includes the SDQ. Future research will investigate the trajectories of behavioural difficulties across the 2 year, 4.5 year and 8 year DCW, which will provide us more insight into the stability of childhood behavioural difficulties. The work from this thesis will be a usual in informing this future research.

It should also be noted that while the complete *Growing Up in New Zealand* cohort is broadly comparable to the current NZ population (Morton et al., 2013), attrition through follow up meant that sample representation for Studies 4 to 6 was affected. Specifically, children lost to follow up from 2 to 4.5 years were more likely to have mothers who were younger, less educated and non-European, more likely to be part of an unplanned pregnancy, and more likely to come from highly deprived and rural areas. As such, these sociodemographic groups are not adequately represented in the overall analytic sample. Furthermore, small cell counts for the Asian and Other maternal ethnic groups for children with persistent difficulties meant that these groups had to be combined in Studies 4 to 6. However, despite these limitations, it should be noted that the retention rate at DCWs is consistently high (92% at 2 years and 90% at 4.5 years), and the analytic sample in the latter studies still consisted of a considerable proportion of the original sample (86%).

7.8. Future directions

There are several ways in which future research can expand upon the findings from the current thesis. Firstly, the current study used mothers' report of child behaviour. However, our results from Study 2 show only moderate agreement across mothers' and fathers' ratings, indicating that parents may be having differing interactions with the child that should be taken into account. As such, using a multi-informant approach may result in a more sensitive identification of children with serious behavioural difficulties. Indeed, R. Goodman, Ford, Corbin and Meltzer (2004) found that the SDQ was more accurate at identifying a psychiatric diagnosis in 5 to 17 year olds when multi-informant scores were used . Unfortunately, this approach was not possible for the current thesis; while the SDQ

was answered by both mothers and fathers at the 2 year DCW, the father-report was only obtained for a subsample of the cohort at age 2 and not measured at 4.5 years. However, it would be of interest to evaluate whether the findings relating to the stability and change in early childhood behavioural problems from Study 4 are replicated when using SDQ scores from multiple informants.

As information on fathers was only available for a subsample of the *Growing Up in New Zealand* cohort, evaluating the influence of paternal factors would have reduced our sample size considerably. This would have likely resulted in small cell counts, particularly for studies looking at the persistence and change in early childhood behavioural problems. As such, the current thesis did not investigate whether fathers' parenting and mental health was associated with early childhood behavioural problems. However, there is evidence to indicate that fathers' involvement is key to children's psychosocial wellbeing (Ramchandani et al., 2013; K. R. Wilson & Prior, 2011), and that paternal parenting and mental health can also moderate the effects of maternal mental health and parenting on child behaviour (Braza et al., 2015; Kahn, Brandt, & Whitaker, 2004). We encourage future research into how paternal factors may play a role in the development and persistence of early childhood behavioural difficulties.

It is also important to address how individual differences may influence children's risk of developing and showing persistent behavioural problems. Relevant individual differences to consider include sex and temperament, as these factors in particular may moderate the influence of parenting styles on child behaviour. There is evidence that males are more likely to show externalising disorders during early childhood than females, though the causal factors underlying these differences are yet to be effectively

determined (Rutter, Caspi, & Moffitt, 2003). In addition, there is also evidence of interactive effects on child behaviour between parenting styles and infant temperament. Specifically, research has shown that harsh parenting appears to exacerbate the association between difficult infant temperaments and subsequent behavioural problems (Morris et al., 2002), whereas greater maternal sensitivity appears to reduce this association (Bradley & Corwyn, 2008). Therefore, it would be informative to evaluate whether factors associated with the persistence and change in early behavioural problems are moderated by these measures of individual differences.

While the current thesis adjusted for maternal ethnicity in analyses, the reasons underlying ethnic differences were not explored. This was because it was felt that understanding ethnic and cross-cultural differences could constitute an entire thesis in and of itself. However, a cross-cultural approach would add to the work established by this thesis. Specifically, it would be useful to determine whether risk or protective factors differ across various ethnic groups, and the role that cultural identity may play in the general resilience of the family and child. An important statistic to consider for multicultural communities comes from a meta-analysis by Griner and Smith (2006), who found that culturally adapted mental health interventions in adolescents and adults are four times more effective than general interventions. Given the broad cultural and ethnic diversity within New Zealand (Statistics New Zealand, 2014) as well as our descriptive results from Studies 1 and 4 indicating ethnic disparities in early childhood behavioural difficulties, this is an important avenue for future research and clinical application.

7.9. General conclusion

Overall, the current thesis has several implications for initiatives that target early childhood behavioural problems. We demonstrated that the SDQ could be used to measure behavioural difficulties in children as young as 2 years old, as it showed acceptable psychometric properties within this age group. In addition, it was demonstrated that behavioural problems were not necessarily stable during early childhood, as some but not all children who showed behavioural difficulties at 2 years persisted in these difficulties at 4.5 years. Importantly, by accounting for a broad range of predictors within the family context, this thesis suggested that a multisystemic, family-centred approach is important for targeting early childhood behavioural difficulties. Specifically, not only should intervention efforts promote helpful behavioural regulation in the child, but also address the mother's mental health and parenting behaviour. Factors such as formal (external) and informal (family and friends) social support may be particularly beneficial for families of children with behavioural problems. Finally, children with preschool behavioural problems are also more likely to show cognitive delays, therefore intervention efforts should appropriately address *all* challenges present in the child. Future research should build upon this work by investigating the role of fathers and the potential moderating influences of the child's sex, temperament, and family culture/ethnicity.

Appendix A

Preschool Strengths and Difficulties Questionnaire from 2 year DCW

	1) Not True	**2) Somewhat True**	**3) Certainly True**	**4) Ref**	**5) DK**
(SDQ1) Considerate of other people's feelings					
(SDQ2) Restless, overactive, cannot stay still for long					
(SDQ3) Often complains of headaches, stomach- aches, or sickness					
(SDQ4) Shares readily with other children (treats, toys, pencils, etc.)					
(SDQ5) Often has temper tantrums or hot tempers					
(SDQ6) Rather solitary, tends to play alone					
(SDQ7) Generally obedient, usually does what adults request					
(SDQ8) Many worries, often seems worried					
(SDQ9) Helpful if someone is hurt, upset or feeling ill					
(SDQ10) Constantly fidgeting or squirming					
(SDQ11) Has at least one good friend					
(SDQ12) Often fights with other children or bullies them					
(SDQ13) Often unhappy, down-hearted or tearful					

	1) Not True	2) Somewhat True	3) Certainly True	4) Ref	5) DK
(SDQ14) Generally liked by other children	◯	◯	◯	◯	◯
(SDQ15) Easily distracted, concentration wanders	◯	◯	◯	◯	◯
(SDQ16) Nervous or clingy in new situations, easily loses confidence	◯	◯	◯	◯	◯
(SDQ17) Kind to younger children	◯	◯	◯	◯	◯
(SDQ18) Often argumentative with adults	◯	◯	◯	◯	◯
(SDQ19) Picked on or bullied by other children	◯	◯	◯	◯	◯
(SDQ20) Often volunteers to help others (parents, teachers, other children)	◯	◯	◯	◯	◯
(SDQ21) Can stop and think things out before acting	◯	◯	◯	◯	◯
(SDQ22) Can be spiteful to others	◯	◯	◯	◯	◯
(SDQ23) Gets on better with adults than with other children	◯	◯	◯	◯	◯
(SDQ24) Many fears, easily scared	◯	◯	◯	◯	◯
(SDQ25) Sees tasks through to the end, good attention span	◯	◯	◯	◯	◯

Study 1 Supplementary Material

Table S1.
Mean prosocial score split by child's gender, mother's ethnicity and socioeconomic status and analysis of group differences.

	N	M (SD)	Test statistic[a]
Gender			9.07**
Male	2823	6.93 (1.85)	
Female	2658	7.37 (1.75)	
Ethnicity			0.19
European	3145	7.15 (1.83)	
Māori	759	7.12 (1.78)	
Pacific Peoples	720	7.12 (1.78)	
Asian	668	7.10 (1.85)	
Deprivation			3.44*[b]
High	1952	7.09 (1.81)	
Medium	1996	7.11 (1.83)	
Low	1533	7.24 (1.79)	

Note: * $p < .05$, ** $p < .001$
[a] independent samples *t*-test conducted with child's gender; ANOVA conducted with mother's ethnicity and deprivation status.
[b] difference between high deprivation and low deprivation was significant ($p = .044$); no other significant differences.

Appendix B

Study 3 Supplementary Material

Table S1.
Frequency distributions of SDQ subscales and total difficulties for categorical control variables.

	Emotional Symptoms		Peer Problems		Hyperactivity-Inattention		Conduct Problems		Total Difficulties	
	Normal/ Borderline n (%)	Abnormal n (%)	Normal/ Borderline n (%)	Abnormal n (%)	Normal/ Borderline n (%)	Abnormal n (%)	Normal/ Borderline n (%)	Abnormal n (%)	Normal/ Borderline n (%)	Abnormal n (%)
Mother's ethnicity										
European	3384 (58.6)	94 (21.0)	3274 (58.4)	202 (32.7)	3207 (56.1)	272 (54.2)	3223 (59.1)	255 (33.2)	3322 (59.5)	154 (24.6)
Maori	745 (12.9)	91 (20.3)	712 (12.7)	123 (19.9)	750 (13.1)	85 (16.9)	627 (11.5)	209 (27.2)	674 (12.1)	160 (25.5)
Pacific	656 (11.4)	173 (38.6)	676 (12.1)	153 (24.8)	761 (13.3)	68 (13.5)	616 (11.3)	212 (27.6)	620 (11.1)	208 (33.2)
Asian	786 (13.6)	75 (16.7)	738 (13.2)	123 (19.9)	800 (14.0)	60 (12.0)	795 (14.6)	67 (8.7)	773 (13.8)	85 (13.6)
Other	204 (3.5)	15 (3.3)	202 (3.6)	16 (2.6)	202 (3.5)	17 (3.4)	193 (3.5)	26 (3.4)	198 (3.5)	20 (3.2)
Mother's education										
No secondary school	342 (5.9)	60 (13.5)	325 (5.8)	77 (12.5)	351 (6.1)	51 (10.1)	275 (5.0)	127 (16.6)	303 (5.4)	99 (15.9)
Secondary school/diploma/trade certificate	3034 (52.5)	302 (68.0)	2951 (52.7)	384 (62.3)	3036 (53.1)	298 (59.2)	2826 (51.8)	510 (66.5)	2895 (51.8)	435 (69.7)
Bachelor's degree or higher	2403 (41.6)	82 (18.5)	2327 (41.5)	155 (25.2)	2332 (40.8)	154 (30.6)	2355 (43.2)	130 (16.9)	2392 (42.8)	90 (14.4)
Mother's age										
< 20 years	228 (3.9)	42 (9.3)	220 (3.9)	50 (8.1)	220 (3.8)	50 (9.9)	192 (3.5)	78 (10.1)	196 (3.5)	74 (11.7)
20-29 years	2147 (37.1)	228 (50.7)	2069 (36.8)	305 (49.4)	2162 (37.7)	210 (41.6)	1958 (35.8)	416 (54.0)	2027 (36.2)	343 (54.4)
≥ 30 years	3416 (59.0)	180 (40.0)	3330 (59.3)	263 (42.6)	3353 (58.5)	245 (48.5)	3320 (60.7)	277 (35.9)	3379 (60.3)	213 (33.8)
Child's gender										
Male	3009 (52.0)	228 (50.7)	2879 (51.2)	356 (57.5)	2941 (51.3)	296 (58.6)	2837 (51.9)	400 (51.9)	2878 (51.4)	357 (56.7)
Female	2783 (48.0)	222 (49.3)	2740 (48.8)	263 (42.5)	2795 (48.7)	209 (41.4)	2634 (48.1)	371 (48.1)	2725 (48.6)	273 (43.3)
Parity										
First born	2452 (42.4)	181 (40.3)	2337 (41.6)	294 (47.6)	2405 (42.0)	227 (45.0)	2363 (43.2)	270 (35.1)	2375 (42.4)	255 (40.6)
Subsequent	3333 (57.6)	268 (59.7)	3276 (58.4)	323 (52.4)	3324 (58.0)	277 (55.0)	3101 (56.8)	500 (64.9)	3222 (57.6)	373 (59.4)
Planned pregnancy										
Planned	3623 (62.8)	202 (45.4)	3518 (62.9)	305 (49.4)	3550 (62.2)	274 (54.6)	3520 (64.6)	305 (39.8)	3567 (63.9)	254 (40.6)
Unplanned	2145 (37.2)	243 (54.6)	2074 (37.1)	312 (50.6)	2160 (37.8)	228 (45.4)	1926 (35.4)	462 (60.2)	2011 (36.1)	372 (59.4)
Mother in paid employment										
Yes	3132 (54.1)	157 (35.0)	3027 (53.9)	258 (41.7)	3063 (53.5)	227 (45.0)	2986 (54.6)	303 (39.6)	3062 (54.7)	223 (35.5)
No	2653 (45.9)	291 (65.0)	2584 (46.1)	360 (58.3)	2665 (46.5)	277 (55.0)	2481 (45.4)	463 (60.4)	2533 (45.3)	406 (64.5)

Table S1 Continued.

	Emotional Symptoms		Peer Problems		Hyperactivity-Inattention		Conduct Problems		Total Difficulties	
	Normal/ Borderline n (%)	Abnormal n (%)	Normal/ Borderline n (%)	Abnormal n (%)	Normal/ Borderline n (%)	Abnormal n (%)	Normal/ Borderline n (%)	Abnormal n (%)	Normal/ Borderline n (%)	Abnormal n (%)
Mother smoking at 2 years										
Smoker	736 (12.7)	105 (23.4)	705 (12.6)	135 (21.8)	734 (12.8)	106 (21.0)	586 (10.7)	254 (33.1)	646 (11.5)	192 (30.5)
Non-smoker	5048 (87.3)	344 (76.6)	4906 (87.4)	483 (78.2)	4994 (87.2)	398 (79.0)	4879 (89.3)	514 (66.9)	4949 (88.5)	437 (69.5)
Area-level deprivation										
Low	1602 (28.3)	65 (14.7)	1562 (28.5)	102 (16.8)	1553 (27.7)	114 (23.0)	1563 (29.3)	104 (13.8)	1581 (28.9)	83 (13.4)
Medium	2121 (37.5)	114 (25.9)	2060 (37.6)	174 (28.7)	2060 (36.8)	176 (35.5)	2018 (37.8)	217 (28.7)	2071 (37.9)	163 (26.3)
High	1931 (34.2)	262 (59.4)	1863 (34.0)	330 (54.5)	1985 (35.5)	206 (41.5)	1758 (32.9)	435 (57.5)	1815 (33.2)	373 (60.3)
Rurality										
Urban	5174 (91.5)	426 (96.6)	5024 (91.6)	573 (94.6)	5133 (91.7)	465 (93.8)	4882 (91.4)	718 (95.0)	4996 (91.4)	596 (96.3)
Rural	482 (8.5)	15 (3.4)	463 (8.4)	33 (5.4)	467 (8.3)	31 (6.3)	459 (8.6)	38 (5.0)	473 (8.6)	23 (3.7)

Table S2.
Descriptive information for gestational age and birthweight across SDQ categories.

	Emotional Symptoms		Peer Problems		Hyperactivity-Inattention		Conduct Problems		Total Difficulties	
	Normal/ Borderline M (SD)	Abnormal M (SD)	Normal/ Borderline M (SD)	Abnormal M (SD)	Normal/ Borderline M (SD)	Abnormal M (SD)	Normal/ Borderline M (SD)	Abnormal M (SD)	Normal/ Borderline M (SD)	Abnormal M (SD)
Gestational age (weeks)	39.13 (1.80)	39.15 (1.69)	39.14 (1.80)	39.11 (1.74)	39.15 (1.79)	38.98 (1.80)	39.14 (1.79)	39.09 (1.83)	39.14 (1.79)	39.11 (1.83)
Birth weight (grams)	3500.36 (571.50)	3507.03 (569.63)	3503.86 (569.12)	3474.80 (590.77)	3505.88 (570.20)	3444.35 (581.76)	3503.62 (569.84)	3481.54 (581.63)	3504.60 (569.82)	3470..13 (585.82)

Table S3.
Correlation coefficients between each significant predictor in final models and sociodemographic control variables.

	Prenatal perceived stress	Folate intake	Exposure to another smoker	Exclusive breastfeeding	Postnatal anxiety	Verbal conflict	Informal support	Maternal evaluation
Mother's ethnicity	0.22	0.56	0.27	-0.01	0.07	0.16	-0.05	0.13
Mother's education	0.23	0.45	0.46	0.14	0.12	0.29	-0.07	0.06
Maternal age	-0.23	-0.50	-0.44	-0.17	-0.14	-0.20	-0.10	-0.05
Gestational age (weeks)	-0.05	0.02	0.02	0.00	-0.02	0.01	0.02	0.02
Birthweight (grams)	-0.01	-0.01	-0.09	-0.01	0.00	0.03	0.01	0.01
Child's gender	0.01	0.01	-0.02	0.05	0.02	0.00	-0.1	-0.01
Parity	-0.07	-0.11	0.08	0.15	-0.03	-0.09	0.12	0.03
Planned pregnancy	0.26	0.77	0.43	0.04	0.15	0.22	-0.05	0.02
Mother in paid employment	0.11	0.22	0.27	-0.05	0.06	0.07	-0.11	0.07
Area-level deprivation	0.18	0.39	0.32	0.02	0.08	0.15	-0.01	0.09
Rurality	-0.07	-0.10	0.00	0.03	0.01	-0.01	0.05	-0.02

So that correlations could be assessed, nominal variables in the main analyses were treated as binary in the current analyses; these variables included folate intake (recommended vs not recommended), mother’s ethnicity (European vs non-European), and mother’s education (Secondary school vs no secondary school).

Pearson product moment correlations were calculated between continuous variables; polyserial correlations were calculated between ordinal and continuous variables; polychoric correlations were calculated between all categorical (binary or ordinal) variables. Cohen’s (1998) guidelines should be used to interpret coefficient effect sizes (small effect = 0.1; medium effect = 0.3; large effect = 0.5).

Appendix C

Standard Strengths and Difficulties Questionnaire from 4.5 year DCW

	1) Not True	**2) Somewhat True**	**3) Certainly True**	**4) Ref**	**5) DK**
(SDQ1) Considerate of other people's feelings					
(SDQ2) Restless, overactive, cannot stay still for long					
(SDQ3) Often complains of headaches, stomach- aches, or sickness					
(SDQ4) Shares readily with other children (treats, toys, pencils, etc.)					
(SDQ5) Often loses temper					
(SDQ6) Rather solitary, prefers to play alone					
(SDQ7) Generally well behaved, usually does what adults request					
(SDQ8) Many worries or often seems worried					
(SDQ9) Helpful if someone is hurt, upset or feeling ill					
(SDQ10) Constantly fidgeting or squirming					
(SDQ11) Has at least one good friend					
(SDQ13) Often unhappy, down-hearted or tearful					

	1) Not True	2) Somewhat True	3) Certainly True	4) Ref	5) DK
(SDQ14) Generally liked by other children	◯	◯	◯	◯	◯
(SDQ15) Easily distracted, concentration wanders	◯	◯	◯	◯	◯
(SDQ16) Nervous or clingy in new situations, easily loses confidence	◯	◯	◯	◯	◯
(SDQ17) Kind to younger children	◯	◯	◯	◯	◯
(SDQ18) Often lies or cheats	◯	◯	◯	◯	◯
(SDQ19) Picked on or bullied by other children	◯	◯	◯	◯	◯
(SDQ20) Often volunteers to help others (parents, teachers, other children)	◯	◯	◯	◯	◯
(SDQ21) Thinks things out before acting	◯	◯	◯	◯	◯
(SDQ22) Steals from home, pre-school or elsewhere	◯	◯	◯	◯	◯
(SDQ23) Gets on better with adults than with other children	◯	◯	◯	◯	◯
(SDQ24) Many fears, easily scared	◯	◯	◯	◯	◯
(SDQ25) Good attention span, sees chores or work through to the end	◯	◯	◯	◯	◯

Table C1
Responses to the SDQ conduct items at age 2 [with corresponding 54m data]

Response	Temper	Obedient*	Fights	Argues	Spiteful	[Lies]	[Steals]
Not true	22% [39%]	33% [47%]	62%	51%	69%	[68%]	[87%]
Somewhat true	53% [48%]	62% [49%]	31%	40%	28%	[30%]	[11%]
Certainly true	25% [13%]	5% [3.5%]	7.5%	9%	3.5%	[2%]	[2%]

Note: * scores reversed; missing item in grey column

Table C2.
Comparison of age 2 conduct and total difficulties SDQ results with and without the missing item from 4.5 years

	Conduct problems			Total difficulties		
	25 items	24 items[a]	Test statistic	25 items	24 items	Test statistic
M (SD)	3.13 (1.97)	3.47 (2.04)	-40.50**[b]	11.53 (5.16)	11.87 (5.17)	-40.56**[b]
Normal n (%)	4748 (76.1%)	4384 (70.3%)	6262.42**[c]	4871 (78.2%)	4764 (76.5%)	9170.90**[c]
Borderline n (%)	718 (11.5%)	1005 (16.1%)		728 (11.7%)	794 (12.7%)	
Abnormal n (%)	771 (12.4%)	848 (13.6%)		630 (10.1%)	671 (10.8%)	

Note: ** $p < .001$
[a] conduct problem scores for 24 items calculated using four items and scaled up pro-rata to a range of 0-10
[b] t-statistic from paired sample t-test
[c] Pearson chi-square statistic

Table C3.
Standardised factor loadings for the original and modified five-factor models using 4.5 year SDQ data

	Original Model					Modified Model				
Item	Emotional Symptoms	Peer Problems	Hyperactivity-Inattention	Conduct Problems [a]	Prosocial Behaviour	Emotional Symptoms	Peer Problems	Hyperactivity-Inattention	Conduct Problems [a]	Positive Construal
3. Somatic	.58					.59				
8. Worries	.71					.71				
13. Unhappy	.82					.81				
16. Clingy	.48					.47				
24. Fears	.68					.68				
6. Solitary		.52					.59			
11. Good friend*		.56					.36			-.37
14. Popular*		.72					.42			-.52
19. Bullied		.56					.65			
23. Best with adults		.52					.63			
2. Restless			.78					.81		
10. Fidgety			.77					.80		
15. Distractible			.75					.79		
21. Reflective*			.47					.21		-.43
25. Persistent*			.60					.39		-.39
5. Tempers				.57					.65	
7. Well behaved*				.63					.36	-.45
18. Lies				.37					.42	
22. Steals				.38					.43	
1. Considerate					.75					.72
4. Shares					.61					.60
9. Caring					.70					.69
17. Kind to kids					.70					.68
20. Helps out					.59					.62

Note: * reverse-scored items

[a] Factor loadings only presented for 4 items due to missing item 12 (‘Fights’)

Cronbach’s alpha: emotional symptoms $\alpha = .63$; peer problems $\alpha = .55$; hyperactivity-inattention $\alpha = .72$; conduct problems $\alpha = .47$; original prosocial $\alpha = .69$; positive construal $\alpha = .75$; total difficulties $\alpha = .77$.

Appendix D

Study 6 Supplementary Material

Table S1.
Binomial logistic regression predicting the development of difficulties from 2 to 4.5 years for control variables.

	B (SE)	OR (95% CI)	z-value
Mother's ethnicity			
European			
Maori	0.38 (0.20)	1.46 (0.97, 2.17)	1.85
Pacific	0.86 (0.21)	2.37 (1.57, 3.56)	4.13**
Asian/Other	0.60 (0.19)	1.83 (1.25, 2.65)	3.16*
Mother's education			
No secondary school			
Secondary school/diploma/trade certificate	-0.19 (0.25)	0.83 (0.51, 1.38)	-0.74
Bachelor's degree or higher	-0.70 (0.30)	0.49 (0.28, 0.89)	-2.38*
Mother's age			
<20 years			
20 to 29 years	-0.28 (0.29)	0.75 (0.43, 1.35)	-0.98
30 years and over	-0.71 (0.31)	0.49 (0.27, 0.92)	-2.28*
Child's gender			
Male			
Female	-0.27 (0.13)	0.76 (0.59, 0.99)	-2.04*
Gestational age	-0.01 (0.04)	0.99 (0.91, 1.08)	-0.22
Birthweight	0.00 (0.00)	1.00 (1.00, 1.00)	-1.55
Parity			
First born			
Subsequent birth	-0.23 (0.15)	0.79 (0.59, 1.05)	-1.61
Planned pregnancy			
Yes			
No	0.06 (0.15)	1.06 (0.80, 1.42)	0.42
Exclusive breastfeeding			
<6 months	0.05 (0.16)	1.05 (0.77, 1.46)	0.33
6 months or more			
Area-level deprivation			
Low			
Medium	0.23 (0.19)	1.26 (0.87, 1.85)	1.19
High	0.69 (0.20)	1.99 (1.34, 2.97)	3.39**

Note: $^{**}p < .001$, $^{*}p < .05$.

Table S2.
Results from the multinomial logistic regression for control variables.

	No difficulties vs Persistent difficulties			Improved vs Persistent difficulties			Later difficulties vs Persistent difficulties		
	B (SE)	OR (95% CI)	z-value	*B* (SE)	OR (95% CI)	z-value	*B* (SE)	OR (95% CI)	z-value
Mother's ethnicity									
European									
Maori	-0.90 (0.29)	0.41 (0.23, 0.72)	-3.09*	-0.23 (0.35)	0.79 (0.40, 1.58)	-0.66	-0.50 (0.33)	0.61 (0.32, 1.16)	-1.51
Pacific	-1.53 (0.29)	0.22 (0.12, 0.39)	-5.20**	-0.38 (0.35)	0.69 (0.34, 1.37)	-1.07	-0.68 (0.33)	0.51 (0.27, 0.97)	-2.04*
Asian/Other	-0.69 (0.33)	0.50 (0.26, 0.96)	-2.09*	0.23 (0.38)	1.26 (0.60, 2.65)	0.61	-0.10 (0.37)	0.91 (0.44, 1.87)	-0.26
Mother's education									
No secondary school									
Secondary school/diploma/trade certificate	-0.25 (0.35)	0.78 (0.39, 1.55)	-0.72	-0.21 (0.42)	0.81 (0.36, 1.85)	-0.50	-0.47 (0.38)	0.63 (0.30, 1.33)	-1.21
Bachelor's degree or higher	0.37 (0.45)	1.45 (0.60, 3.49)	0.83	-0.36 (0.53)	0.69 (0.25, 1.97)	-0.69	-0.35 (0.49)	0.70 (0.27, 1.84)	-0.72
Mother's age									
<20 years									
20 to 29 years	0.72 (0.34)	2.05 (1.06, 3.96)	2.13*	0.11 (0.40)	1.11 (0.51, 2.44)	0.27	0.46 (0.38)	1.58 (0.75, 3.33)	1.20
30 years and over	1.25 (0.39)	3.48 (1.63, 7.45)	3.22**	0.35 (0.46)	1.42 (0.58, 3.49)	0.76	0.58 (0.44)	1.79 (0.76, 4.23)	1.33
Child's gender									
Male									
Female	0.32 (0.19)	1.37 (0.94, 2.00)	1.65	0.08 (0.23)	1.08 (0.69, 1.69)	0.33	0.03 (0.22)	1.03 (0.68, 1.57)	0.15
Gestational age	-0.05 (0.07)	0.95 (0.83, 1.08)	-0.76	-0.01 (0.08)	0.99 (0.84, 1.16)	-0.12	-0.06 (0.08)	0.94 (0.81, 1.09)	-0.79
Birthweight	0.00 (0.00)	1.00 (1.00, 1.00)	1.85	0.00 (0.00)	1.00 (1.00, 1.00)	0.73	0.00 (0.00)	1.00 (1.00, 1.00)	0.62
Parity									
First born									
Subsequent birth	0.001 (0.22)	1.00 (0.65, 1.54)	-0.01	-0.12 (0.26)	0.89 (0.53, 1.48)	-0.46	-0.22 (0.25)	0.80 (0.50, 1.30)	-0.90
Planned pregnancy									
Yes									
No	-0.26 (0.21)	0.77 (0.51, 1.17)	-1.23	-0.25 (0.25)	0.78 (0.48, 1.27)	-1.01	-0.14 (0.24)	0.87 (0.55, 1.38)	-0.58

Table S2 Continued.

	No difficulties vs Persistent difficulties			Improved vs Persistent difficulties			Later difficulties vs Persistent difficulties		
	B (SE)	OR (95% CI)	z-value	*B* (SE)	OR (95% CI)	z-value	*B* (SE)	OR (95% CI)	z-value
Exclusive breastfeeding									
<6 months	-0.19 (0.24)	0.82 (0.51, 1.33)	-0.79	0.02 (0.29)	1.02 (0.58, 1.82)	0.08	-0.14 (0.27)	0.87 (0.51, 1.49)	-0.50
6 months or more									
Area-level deprivation									
Low									
Medium	-0.35 (0.34)	0.71 (0.36, 1.39)	-1.01	-0.37 (0.39)	0.69 (0.32, 1.49)	-0.93	-0.14 (0.38)	0.87 (0.41, 1.84)	-0.37
High	-0.70 (0.35)	0.50 (0.25, 0.98)	-2.03*	-0.41 (0.40)	0.66 (0.30, 1.44)	-1.04	-0.02 (0.39)	0.98 (0.46, 2.08)	-0.06

Note: $^{**}p < .001$, $^{*}p < .05$.

Appendix E

Table E1.
Number of children diagnosed with specific mental and behavioural disorders at age 2 and associated 2 year SDQ descriptives

			Emotion		Peer		Hyper		Conduct		Total Difficulties	
ICD-10 code	**Diagnosis (2 years)**	**n**	**Mean (range)**	**Proportion with difficulties [a]**	**Mean (range)**	**Proportion with difficulties [a]**	**Mean (range)**	**Proportion with difficulties [a]**	**Mean (range)**	**Proportion with difficulties [a]**	**Mean (range)**	**Proportion with difficulties [a]**
F50.5	Vomiting associated with other psychological disturbance	1	5	100%	6	100%	6	0%	7	100%	24	100%
F63.3	Trichotillomania	1	5	100%	0	0%	4	0%	1	0%	10	0%
F80	Disorders of psychological development	1	1	0%	5	100%	3	0%	1	0%	10	0%
F80.8	Other developmental disorders of speech and language	1	1	0%	4	0%	8	100%	4	0%	17	0%
F80.9	Developmental disorder of speech and language, unspecified	21	1.62 (0-7)	4.76%	2.62 (0-6)	9.52%	5.52 (1-10)	9.52%	3.29 (1-8)	4.76%	13.05 (3-28)	9.52%
F81.0	Specific reading disorder	1	7	100%	4	0%	6	0%	3	0%	20	100%
F84.0	Childhood autism	4	3.25 (3-4)	0%	5.50 (4-7)	75%	7 (5-10)	25%	5.5 (3-10)	25%	21.25 (15-30)	75%
F90.0	Disturbance of activity and attention	2	1.50 (1-2)	0%	5 (4-6)	50%	8.5 (8-9)	100%	7.5 (7-8)	100%	22.50 (21-24)	100%
F91.9	Conduct disorder, unspecified	2	2.50 (2-3)	0%	7 (7-7)	100%	7.5 (5-10)	50%	7.5 (7-8)	100%	24.50 (21-28)	100%
F98.8	Other specified behavioural and emotional disorders with onset usually occurring in childhood and adolescence	1	3	0%	1	0%	4	0%	5	0%	13	0%

Note: Range in scores have not been presented for counts of 1.
[a] Difficulties is defined as scoring within the abnormal range.

Table E2.
Number of children diagnosed with specific mental and behavioural disorders at age 2 and associated 4.5 year SDQ descriptives

			Emotion		Peer		Hyper		Conduct		Total Difficulties	
ICD-10 code	**Diagnosis (2 years)**	**n**	**Mean (range)**	**Proportion with difficulties [a]**	**Mean (range)**	**Proportion with difficulties [a]**	**Mean (range)**	**Proportion with difficulties [a]**	**Mean (range)**	**Proportion with difficulties [a]**	**Mean (range)**	**Proportion with difficulties [a]**
F50.5	Vomiting associated with other psychological disturbance	1	1	0%	0	0%	5	0%	1	0%	7	0%
F63.3	Trichotillomania	1	3	0%	1	0%	3	0%	1	0%	8	0%
F80	Disorders of psychological development	1	1	0%	1	0%	1	0%	3	0%	6	0%
F80.8	Other developmental disorders of speech and language	1	4	0%	2	0%	8	100%	4	0%	18	100%
F80.9	Developmental disorder of speech and language, unspecified	20	2.35 (0-7)	15.00%	2.05 (0-6)	20.00%	5.45 (1-10)	30.00%	3.45 (0-10)	25.00%	13.3 (4-26)	30.00%
F81.0	Specific reading disorder	1	2	0%	5	100%	9	100%	3	0%	19	100%
F84.0	Childhood autism	4	2 (0-4)	0%	3.75 (1-5)	75%	6.75 (5-10)	50%	3	25%	15.5 (11-20)	50%
F90.0	Disturbance of activity and attention	2	2 (2-2)	0%	4 (3-5)	50%	8 (7-9)	100%	7.5 (6-9)	100%	21.50 (20-23)	100%
F91.9	Conduct disorder, unspecified	2	4 (3-5)	50%	4 (3-5)	50%	5 (2-8)	50%	3.5 (3-4)	0%	16.50 (11-22)	50%
F98.8	Other specified behavioural and emotional disorders with onset usually occurring in childhood and adolescence	1	3	0%	3	0%	2	0%	4	0%	12	0%

Note: Range in scores have not been presented for counts of 1.
[a] Difficulties is defined as scoring within the abnormal range.
One child with an F80.9 diagnosis did not have SDQ information at 4.5 years, therefore 4.5 year SDQ information is only presented for 34 children in total

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