Maternal and Child Psychopathology

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Dedicated to my mammy

Shelagh Bond

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Abstract

Evidence suggests that maternal depressed mood (MDM) and childhood emotional and behavioural disorders (EBDs) frequently co-occur. The aim of this thesis is to investigate the nature of how these psychopathologies develop together across childhood.

This epidemiology study uses a large British birth cohort, the Millennium Cohort Study, which charts the development of over 19,000 families throughout the UK. Five subscales of child behaviour were assessed using the preschool Strengths and Difficulties Questionnaire (SDQ) measured at age 3 and the standard school-age SDQ assessed at ages 5, 7, and 11. MDM was measured concurrently using the Kessler 6 scale.

A prerequisite stage of analysis involved testing the psychometric invariance properties of the preschool SDQ (Chapter 2). The reliability and construct validity of this measure was established. Measurement invariance across time and predictive criterion validity were demonstrated across preschool to school-age developmental stages. The preschool SDQ was used in conjunction with the school-age SDQ and MDM scales to confirm reciprocity of mother and child behaviours across childhood in Chapter 3. Bidirectional effects were significant and positive across each assessment. The magnitude of effects did not differ by developmental stage, child gender or by agent (mother/child). In Chapter 4, features of change in mother and child behaviours were assessed. Using second order parallel process growth models, initial levels of MDM and all child behaviours were positively and significantly correlated indicating interrelatedness of maternal and child psychopathologies. Child externalizing behaviours at age 3 were significantly negatively correlated with change in MDM over time thus declines in MDM were lower for mothers of children high in

externalizing behaviours. MDM at age 3 was significantly, positively correlated with change in peer problems, thus children of mothers with high levels of MDM at age 3 had slower declines in peer problems over time.

Results from these studies confirm the interrelatedness of mother and child psychopathologies. Quantitative differences in the relationship between MDM and internalizing compared to MDM and externalizing problems emerged. The practical and clinical implications of these studies are discussed.

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Chapter One: Introduction

1.1. Developmental psychopathology

The emotional and behavioural disorders (EBDs) that children experience are complex and often interwoven, reflecting a diverse range of antecedents and correlates. This heterogeneity evokes an array of behavioural dimensions and presentations that often overlap more than one disorder. Disentangling the causes and consequences of EBDs is important for identification of children at risk and for improving diagnosis, prognosis and treatment of affected children. Disruptive behaviour disorders are characterised by externalizing or undercontrolled behaviours that are directed towards others (e.g. conduct problems), while emotional disorders are characterised by internalizing behaviours that are overcontrolled and directed inwards towards the self (e.g. mood/anxiety disorders). Although internalizing emotional problems and externalizing behavioural problems manifest differently in children, there is evidence that they share a range of genetic and environmental risk factors (Rhee, Lahey, & Waldman, 2014). Moreover, children who experience internalizing or externalizing problems in childhood are at greater risk for psychiatric problems in adolescence and adulthood (Crowell, Puzia, & Yaptangco, 2015; Odgers et al., 2007). One study reported that internalizing (anxiety and depression) and externalizing (aggressive and delinquent) behaviours observed in 4 to 16 year olds predicted adult psychopathology 14 and 24 years later with almost the exact same continuity rate of 29% (Reef, van Meurs, Velhulst, & van der Ende, 2010).

Longitudinal research is a staple of developmental psychopathology. Epidemiological studies chart the course and development of psychopathologies within general population samples across the life course. Longitudinal data allows researchers to understand the multiple risk factors, presentations, correlates and consequences of EBD problems across development. Research is however confounded by several important methodological issues. Behavioural dimensions are not always distinct; children frequently exhibit combinations of internalizing and externalizing behaviours. Understanding child vulnerability to risk factors is hampered by equifinality, i.e. multiple antecedents contribute to one adverse outcome; and multifinality, where one risk factor contributes to several adverse outcomes (Cicchetti & Rogosch, 1996). Finally, high rates of comorbidity may reflect in part substantial overlap in biological, neurological, cognitive, behavioural and social risks. Comorbidity may be explained by heterotypic continuity, in which core impairments manifest differentially across developmental stages, e.g. externalizing difficulties in childhood followed by internalizing difficulties during adolescence; or by homotypic continuity, where one disorder presents persistently across developmental stages, e.g. conduct disorder in childhood progressing to antisocial personality disorder in adulthood.

Developmental psychopathology offers an integrative framework for understanding emerging maladapted behaviours (Braet & van Aken, 2006). From this perspective, fundaments and mechanisms of non-normative development are uncovered by examining similarities between subgroups of individuals (e.g. behavioural style) alongside group differences (e.g. risk factors). Multiple levels of analysis are integrated and synthesized to understand the specific contribution of neurological, biological, social, behavioural, cognitive and genetic factors to developing psychopathologies and more specifically to mechanisms that differentiate subgroups of affected children.

Childhood EBDs are the most prevalent health conditions in children in the UK. In 2004 the Office for National Statistics reported that 10% of children living in the UK received diagnoses in these symptom areas. Conduct disorders were diagnosed in 6% of children, hyperkinetic disorders were diagnosed in 2%, anxiety in 3% and depression in 1% (Green, McGinty, Meltzer, Ford, & Goodman, 2005). In the US approximately 9% of 8 to 15 year olds presented with Attention-Deficit Hyperactivity Disorder (ADHD), 2% had Conduct Disorder (CD), and 1% with anxiety disorders (Merikangas et al., 2010). Boys are usually found to have higher rates of conduct and hyperkinetic disorders while emotional disorders are often reported to be more common in girls (Goodman et al., 2011; Maughan, Rowe, Messer, Goodman, & Meltzer, 2004; Merikangas et al., 2010).

The financial and personal costs associated with EBDs are substantial. In the UK, children with CD cost approximately 10 times more than children with no diagnosis over the life course in public services relating to residential and foster care, educational provisions, health, crime and state benefits. Personal costs involve psychological maladjustment, interpersonal conflict, poorer academic achievement and employment, substance abuse, and incarceration (Scott, Knapp, Henderson, & Maughan, 2001). Externalizing and internalizing disorders are pervasive and associated with impaired socio-emotional and cognitive functioning and difficulties maintaining familial or peer relationships (B. R. Oliver, Barker, Mandy, Skuse, & Maughan, 2011; Pickles et al., 2001; Yan & Dix, 2013).

Disruptive behavioural disorders of childhood are broadly categorised into Oppositional Defiant Disorder (ODD) and Conduct Disorder (CD). Behavioural problems involved in ODD relate to a child's tendency towards anger, irritability, temper tantrums and non-

compliance, whereas CD involves behaviours that are more aggressive towards others or animals, and that violate laws (e.g. theft, vandalism, truancy) and social norms (e.g. precocious sexual activity). Emotional disorders typically include mood disorders such as depression and a range of anxiety disorders. The diagnostic criteria and specifications for each are presented in the following sections. High rates of comorbidity reported in epidemiological research (Angold, Costello, & Erkanli, 1999; Boylan, Vaillancourt, Boyle, & Szatmari, 2007; Rhee et al., 2014) suggest a complex relationship between environmental and genetic risks.

1.1.1. Externalizing disorders

The externalizing behaviours of children can be broadly conceptualized as being undercontrolled and directed towards others. Behaviours typically involve aggressive, hostile, argumentative or disruptive actions against animals, peers and adults. While some degree of externalizing behaviours are to be expected, particularly in younger children who have not yet developed adequate self-regulatory processes, persistent externalizing behaviours can indicate more severe problems that may develop into a behavioural disorder.

Behavioural disorders are currently described in the DSM-5 (APA, 2013) as 'disruptive, impulse-control and conduct disorders' which includes the two most prevalent behavioural problems in children, ODD and CD. In the previous version, DSM-IV (APA, 2000), ODD was operationalized as a precursor to CD insofar as both disorders could not be diagnosed simultaneously, thus diagnosis of CD superseded an ODD diagnosis. However, research suggests that although ODD and CD share multiple genetic and environmental risk factors, there are fundamental differences in relation to behavioural dimensions, diagnostic criteria and child outcomes, which when taken together suggest that these disorders are different

(Maughan et al., 2004; Rowe, Costello, Angold, Copeland, & Maughan, 2010) and this is reflected in DSM-5 where simultaneous diagnosis is allowed.

Prevalence rates of ODD and CD vary significantly by gender. Using data obtained from the Great Smokey Mountains Study, Rowe and colleagues observed that 19.1% of boys achieved the diagnostic criteria for either disorder, compared to only 9.6% of girls. ODD criteria were met by 9.7% of children comprising 7.8% of girls and 11.6% of boys sampled. Differences were more pronounced in the 8.6% of children that met criteria for CD which included 3.7% of girls, compared to 13.2% of boys (Rowe et al., 2010). A similar pattern of results were reported using the British Child and Adolescent Mental Health Survey. Significant gender differences were observed in the prevalence rates of ODD which was present in 1.4% of girls and 3.2% of boys, and were more pronounced in CD of which 2.1% of boys met criteria compared to 0.8% of girls (Maughan et al., 2004). Age trends were also reported in this study. Symptoms of ODD typically emerge much earlier than those of CD. Controlling for rates of comorbidity among affected children, ODD symptoms were reported to increase with age from age 5 to 15 for both boys and girls. By comparison, symptoms of CD emerged later and rose steadily throughout adolescence for both genders (Maughan et al., 2004). Taken together, these findings support the distinction of these disorders.

Research has sought to understand the nature of disruptive behaviours to improve prognosis and treatment. Behavioural dimensions of ODD and CD have been identified and examined in relation to risk factors, correlates, manifestations and sequelae. Factor analysis of the DSM diagnostic criteria for ODD has generated separable behavioural dimensions with distinct features. Across several such studies consensus has wavered between 2- and 3- factor models. Factor configuration has included an irritable dimension relating specifically to anger, temper

tantrums and touchiness; a hurtful dimension that encompasses callous and premeditated forms of aggression; and a headstrong dimension that includes argumentativeness, non-compliance, purposefully irritating others and blame shifting (Stringaris & Goodman, 2009). This 3 factor model has since been replicated in other studies (Aebi, Plattner, Metzke, Bessler, & Steinhausen, 2013), while a two factor model has also been supported in which hurtful and headstrong symptoms form one headstrong/spiteful dimension (Rowe et al., 2010). Dimensions relating to oppositional behaviour, negative affect and antagonistic behaviours have also been reported (Burke, Hipwell, & Loeber, 2010; Burke & Loeber, 2010). However, a recently published study incorporating 5 longitudinal cohort datasets proposed a bifactor model which included 2 correlated behavioural dimensions, irritability and oppositionality, alongside a general factor. The general factor incorporated communalities across behaviours, while the behavioural dimensions comprised of unique variance attributable specifically to irritable and oppositional behaviours. This bifactor model provided the best fit for each of the 5 cohort datasets (Burke et al., 2014).

ODD dimensions demonstrate multifinality in terms of having a range of outcomes. Irritability (or negative affect) predicted internalizing outcomes for children, including emotional and peer problems, depression, anxiety as well as later behavioural problems including CD diagnosis and delinquency. Oppositionality, which had been labelled headstrong and hurtful in previous studies, was more strongly associated with later aggressive and delinquent behaviours, substance use and adult criminality (Aebi et al., 2013; Burke et al., 2010; Burke & Loeber, 2010; Rowe et al., 2010; Stringaris & Goodman, 2009).

The diagnostic criteria for CD can be broadly categorised as aggressive behaviours directed towards people or animals and non-aggressive behaviours including destruction of property,

deceitfulness, theft, and serious violation of social norms and rules. Empirical research supports the distinction of antisocial symptomatology into aggressive and non-aggressive (including delinquency) subgroups with evidence suggesting different aetiologies, causal pathways and outcomes. Aggressive and non-aggressive or delinquent behaviour are mediated by distinct genetic and environmental processes supporting their distinction from each other (Burt & Neiderhiser, 2009; Tackett, Krueger, Iacono, & McGue, 2005). Further, youth who score high on aggressive behaviours are more likely to have presented with conduct problems earlier in life, while delinquent behaviours are more typical of youth whose behaviour becomes disruptive later in adolescence (Frick & Viding, 2009).

Several distinguishable subtypes of aggression may be identified. While physical aggression involves causing actual physical harm to another person/animal, relational aggression is non-physical, and involves attempts to isolate or humiliate others, primarily by attacking the personal relationships of others, for example name calling, rumours and deliberately breaking others' friendships. Relational aggression has been associated with temperament characteristics including high negative affectivity, and personality traits such as high disagreeableness (Tackett, Kushner, Herzhoff, Smack, & Reardon, 2014). Aggression can also be further categorised as proactive, i.e. premeditated, or reactive, i.e. in response to perceived threat (Dodge & Coie, 1987).

Classification by age of onset has become a cornerstone of research and clinical utility regarding behavioural disorders. During childhood, age and severity of symptoms are negatively associated, thus the younger the child is when problem behaviours begin, the greater the severity of symptoms (Frick & Viding, 2009). Moffitt's (1993) developmental taxonomy proposed categorizing children according to their age when problematic

behaviours emerged. So influential was this delineation the DSM included the age of onset classification as a specifier for CD (APA, 2000, 2013). From Moffitt's seminal paper, two distinct categories of antisocial youth are described. A small group (approximately 5% of males) were identified as life-course-persistent (LCP), characterised by problematic behaviour beginning as early as preschool, persisting through adolescence into adulthood. A second adolescent-limited (AL) group (approximately one third of adolescents) is characterized by delinquent behaviours that mimic their LCP peers. Moffitt asserts that the behaviours of LCP youths are primarily the result of neurological risk factors associated with difficult temperament increasing the child's vulnerability to behavioural problems. AL delinquents however were more vulnerable to environmental risk factors exhibiting behaviours that attempt to bridge the gap between biological and social maturity, and typically desist in adulthood (Moffitt, 1993).

Since Moffitt's seminal paper additional subgroups have been included. Further examination of the LCP subgroup characterized by the most severe and persistent conduct problems throughout childhood and into adulthood revealed that a substantial proportion desisted from antisocial behaviours during childhood. Barker and Maughan (2009) reported that over 60% of the LCP subgroup had desisted by early adolescence. This so-called 'childhood-limited' subgroup shared several risk factors with the early-onset subgroup including pre-and post-natal maternal anxiety and depression (Barker & Maughan, 2009). Buck and Dix (2014) examined naturally declining levels of disruptive behaviours during childhood. They proposed that children cease to engage in such behaviours for a number of reasons. These include response to maternal factors such as positive and warm parenting; increased socio-emotional and cognitive skills which equip them to make more compliant behaviour choices; and decreasing reliance on mother (Buck & Dix, 2014).

Child age at onset is also important in distinguishing disorders. ODD symptoms tend to emerge earlier than CD symptoms. Boys were reported to exhibit ODD symptoms from age 2.5, compared to age 5.5 for girls, while CD symptoms were reported to begin at approximately age 4.5 for boys and girls (Rowe, Maughan, Pickles, Costello, & Angold, 2002). This may be explained in part by the nature of the symptoms. Some symptoms of CD are less likely to be applicable to young children, such as serious violation of social norms and rules, or deceitfulness. Distinguishing symptoms might also be problematic in younger children, e.g. temper tantrums (ODD) and aggressive behaviours (CD). It is possible that symptoms may be precursors for alternative psychopathologies, supporting heterotypic continuity of disorders. Not all children with an early onset of problem behaviours continue with antisocial tendency into adulthood, but those that do tend to have more deleterious outcomes than those without antisocial tendencies and those with adolescent limited antisocial behaviours (Frick & Viding, 2009; Maughan & Rutter, 2001; Moffitt, 1993; Moffitt, Caspi, Rutter, & Silva, 2001).

DSM-5 introduced an additional 'with limited prosocial emotions' specifier to the CD diagnostic criteria. Referred to in research literature as callous and unemotional (CU) traits, individuals with this behavioural style have a distinct profile of cognitive and emotional deficits that reflect dimensions of psychopathy. DSM-5 diagnostic criteria highlight specific deficits in remorse/guilt, empathy, concern regarding performance in any domain alongside shallow or deficient affect, with individuals exhibiting fearlessness, thrill-seeking and superficial personality dimensions as well as insensitivity to punishment (APA, 2013). Individuals with limited prosocial emotions represent a particularly predatory subtype of antisocial youth characterised by severe and violent antisocial behaviour, higher rates of

criminality and recidivism (Frick, Stickle, Dandreaux, Farrell, & Kimonis, 2005; Frick & Viding, 2009; Moran et al., 2009).

1.1.2. Internalizing disorders

Internalizing disorders are characterised by behaviours that are overcontrolled, directed towards the self, and constitute withdrawal, anxiety and depressive symptoms. In 2004 the Office of National Statistics reported that emotional disorders were present in 3.7% of children and adolescents in the UK, with 4.3% of girls experiencing emotional problems and 3.1% of boys. Internalizing problems increase in prevalence particularly during middle childhood with enduring adverse consequences for psychosocial functioning (Yap & Jorm, 2015). While behavioural problems were more common in children up to 10 years old, emotional problems were more common in children over 11 years (Green et al., 2005).

Anxiety is the most common emotional disorder in childhood affecting twice as many girls as boys (APA, 2014). The two constituent components of anxiety disorders are fear of actual or perceived threat, and anxiety induced in anticipation of threat. Craske defined anxiety as "a future-oriented mood state associated with preparation for possible, upcoming negative events" (Craske et al., 2009, p. 1067). The anticipation of events being negative activates fear responses that can be manifested mentally and physically, and promotes avoidance. Anxious symptoms have been categorised as: verbal-subjective, including worry, nervousness and imagined threats; overt motor acts including avoidance behaviours; and somato-visceral activity such as nausea, muscle tension and panic responses (Craske et al., 2009; Lang, 1968).

Research has quantitatively distinguished several dimensions of anxious behaviour that can be reliably identified in children. DSM-5 (APA, 2014) includes several anxiety disorders that

can be experienced during childhood including separation anxiety disorder, selective mutism, specific phobias, social anxiety disorder and panic disorder. Anxiety disorders are distinguished by diagnostic features such as age of onset, prevalence rates, whether diagnosis is more common for girls or boys, and typical trajectories such as increasing or decreasing symptoms across childhood (see Table 1.1 for details). Separation anxiety is specific to a child's fears about separation from their major attachment figure, with persistent anxious episodes that impair normative age-appropriate functioning. Selective mutism occurs when children without language difficulties refuse to communicate in specific settings, such as school and has been associated with behavioural inhibition, social withdrawal and isolation, and clinginess. Specific phobias are excessive, persistent and disproportionate fear and anxiety that induces avoidance behaviours. Social anxiety disorder involves fear or discomfort in specific social situations or interactions that expose the individual to social judgement by others. For children, such social contexts usually involve peers rather than adults.

Table 1.1: DSM-5 childhood anxiety disorders (APA, 2014).

Anxiety Disorder	Prevalence	Change with age	Gender prevalence	Age at onset
Separation anxiety disorder	4%	Decrease	Boys and girls	Preschool
Selective mutism	0.03 - 1%	Decrease	Boys and girls	< 5 years
Specific phobias	5%	Increase	Girls	7 - 11 years
Social anxiety disorder	7%	Decrease	Girls	13 years

Depression is the second most prevalent internalizing disorder experienced in childhood. The DSM-5 (APA, 2014) proposes several distinct disorders differentiated by episodic features

such as duration, timing and risk factors, and unified by feelings of persistent sadness, anhedonia or irritable mood, with the presence of somatic symptoms and functional impairment. Few depressive disorders occur during childhood, those that do include disruptive mood dysregulation disorder (DMDD), major depressive disorder (MDD) and persistent depressive disorder (dysthymia). While DMDD has been categorised by the DSM-5 as a depressive disorder, considerable overlap between symptoms of DMDD and externalizing ODD has been documented. One study reported comorbidity with depressive disorders ranging from 9.9 < Odds Ratio < 23.5, while comorbidity with ODD ranged from 52.9 < OR < 103.0 (Copeland, Angold, Costello, & Egger, 2013). While MDD is relatively rare in childhood populations, many features of presentation such as duration of episode, rates of recurrence and recovery periods are comparable across childhood and adolescent samples (Birmaher et al., 2004; Moffitt et al., 2007). Dysthymia or persistent depressive disorder is the presence of pervasive depressed mood in children lasting for at least one year. Outcomes are more severe for childhood onset dysthymia which is frequently comorbid with later personality disorders and substance abuse (DSM-5, APA, 2014).

Mood dysfunction can begin very early in life. Attentional processes in infancy have been associated with developing mood regulation, thus infants with greater attentional processes are less likely to experience mood dysfunction (Martinos, Matheson, & De Haan, 2012). MDD experienced during preschool years was the strongest predictor of depression 12 and 24 months later, with those in the MDD group 4 times more likely to have persistent or recurring depression (Luby, Si, Belden, Tandon, & Spitznagel, 2014). Prevalence rates in preschool samples are comparable to school-aged samples, approximately 1-2% for boys and girls (Egger & Angold, 2006; Maughan, Collishaw, & Stringaris, 2013). In community samples, levels of depressive symptoms increase across childhood (Keenan, Feng, Hipwell, &

Klostermann, 2009). In a meta-analytic review of 310 studies examining scores on the Children's Depression Inventory (Kovacs, 1985), scores were lower for girls than boys during childhood, and increased from age 11 through adolescence. Evidence suggests that boys' depression scores remain stable across childhood and adolescence (Twenge & Nolen-Hoeksema, 2002). Gender differences were observed in internalizing problems during childhood with girls more likely to experience anxiety disorders, depressive episodes and comorbid internalizing disorders (Costello, Mustillo, Erkanli, Keeler, & Angold, 2003; Keenan et al., 2009). Childhood internalizing disorders increased the likelihood of poor health, financial and interpersonal functioning in adulthood (Copeland, Angold, Shanahan, & Costello, 2014; Kasen et al., 2001).

Several genetic and environmental risk factors have been linked to childhood internalizing disorders. Anxiety risk factors include temperamental variation in behavioural inhibition, as well as parental anxiety and peer victimization, however, social competence may act as a protective factor against anxiety (Wichstrøm, Belsky, & Berg-Nielsen, 2013). Risk factors for childhood depression include previous episodes of depression and family history of affective disorders as well as preschool disruptive disorders (Keenan et al., 2009; Luby et al., 2014). Parental factors are associated with anxiety, depression and internalizing problems in children. A meta-analytic review of 141 studies reported that parental factors were associated with childhood depression and internalizing problems that combined depression and anxiety symptoms, but was not linked to anxiety independently of other internalizing difficulties. Specifically, parent-child conflict and aversiveness were associated with depression and internalizing, the latter additionally being associated with parental over-involvement, less warmth and abusive parenting (Yap & Jorm, 2015).

1.1.3. Comorbidity of internalizing and externalizing disorders in childhood

There is no doubt that the presence of internalizing or externalizing disorders during childhood are detrimental to the child's normative functioning with poorer prognoses for future adjustment compared to children without internalizing or externalizing difficulties. Evidence suggests that of those children who are diagnosed with one disorder, there is increased risk for multiple disorders, either in the same domain e.g. comorbid anxiety and depression, or in alternate domains e.g. comorbid conduct disorder and depression (Angold, Costello, & Erkanli, 1999; Maughan et al., 2004; Rhee, Lahey, & Waldman, 2014; Rowe et al., 2002).

Comorbid internalizing disorders have been robustly reported across adult, adolescent and child samples (Egger & Angold, 2006; Ford, Goodman, & Meltzer, 2003; Maughan et al., 2013). Children who present with internalizing disorders in childhood are at an increased risk of experiencing homotypic continuity of internalizing disorders (Cartwright-Hatton, 2013; Keenan et al., 2009; Luby et al., 2014) or heterotypic continuity with subsequent externalizing disorders (Dougherty et al., 2015; Overbeek, Vollebergh, Meeus, Engels, & Luijpers, 2001; Stringaris & Goodman, 2009). High rates of comorbidity between ODD and both internalizing and externalizing problems were also reported in preschool populations (Boylan et al., 2007; Lavigne, Gouze, Bryant, & Hopkins, 2014). One study which examined comorbid internalizing and externalizing disorders reported that boys from age 2 to age 6 with high levels of externalizing problems also tend to have higher levels of internalizing problems. Moreover, change in their levels of internalizing and externalizing behaviours over the period were correlated, thus increases in one domain were matched with increases in the other (Gilliom & Shaw, 2004). Similarly, another study also reported that children between the ages of 5 and 13 with high initial levels of internalizing difficulties also had high initial

levels of externalizing problems and that for children who increased in difficulties over time in one domain, tended to do so in the other domain simultaneously (Keiley, Bates, Dodge, & Pettit, 2000).

Comorbidity can be explained in part by genetic factors that overlap across disorders within and across domain (Eley, 1997). Studies that compare genetically related and unrelated groups have the potential to quantify the extent to which familial similarity in psychopathology is genetically or environmentally mediated. For example twin studies compare associations with monozygotic twins (MZ) who share 100% of their genes with those of dizygotic twins (DZ) who share 50% of their genes. Research using twin studies has reported shared genetic factors that are common to both anxiety and depression to account for 80% of the correlation between the two disorders (Eley & Stevenson, 1999). In another study, genetic factors were more strongly associated with aggressive compared to non-aggressive behaviours. Moreover, gender differences were such that for girls, correlations between aggressive and non-aggressive behaviour were predominantly genetically mediated, whereas for boys, this link was more environmentally mediated (Eley, Lichtenstein, & Stevenson, 1999). Such factors have the potential to account for individual vulnerability to environmental factors that underpin multiple psychiatric problems.

In a more recent genetically sensitive study, dimensions of ODD were examined in relation to later depression and delinquency to determine the extent of genetic and environmental contributions across domains (Stringaris, Zavos, Leibenluft, Maughan, & Eley, 2012). Irritability, which was more prevalent in girls, was more strongly genetically associated with later depression than with later delinquency; while headstrong/hurtful, for which boys scored higher, was genetically associated with delinquency. Moreover, when prior irritability was

controlled, no significant genetic variance between headstrong/hurtful and depression remained. Likewise, when prior headstrong/hurtful behaviours were controlled, no genetic variance remained in the association between irritability and later depression. This suggests that comorbidity across internalizing and externalizing problems is genetically mediated.

The dimensionality, persistence and comorbidity of all psychiatric disorders were recently examined in a study that identified 3 dimensions of psychopathology: internalizing, externalizing and thought disorders which include a psychosis component (e.g. schizophrenia), which are concomitant with a general psychopathology or p factor (Caspi et al., 2014). The p factor represents individual vulnerability to any psychiatric disorder that is persistent and comorbid, and emerges early in life and unfolds across several developmental stages. Individuals with a high p score are more likely to have a family history of psychopathology; have experienced adversity or maltreatment from an early age; have received a psychiatric diagnosis by age 15; and have neurological impairments relating to concentration, attention, control and co-ordination. The externalizing factor was also independently related to family history of psychopathology, suggesting that externalizing, but not internalizing behaviours were intergenerationally transmitted over and beyond the contribution of the general p factor (Caspi et al., 2014).

1.1.4. Early identification of childhood EBDs

Early onset of psychopathology often signifies high risk of persistent problems across the lifespan (Moffitt, 1993), therefore the early identification of emotional and behavioural problems is vital. Preschool is an optimal period for identifying and treating childhood psychopathology however identifying problematic behaviour in preschool populations raises several methodological concerns. Distinguishing problem behaviour from normative

developmental behaviours is difficult as the toddler and preschool period is a period of rapid cognitive, physical, emotional and social development.

The prevalence rates of both internalizing and externalizing problems in preschool children has been reported as comparable to those of childhood (Egger & Angold, 2006; Wichstrøm et al., 2012). This suggests that it is possible to reliably distinguish between normative and maladjusted behaviours in preschool populations, and moreover to differentiate between subtypes of behaviours in this age group. Studies have demonstrated that the presence of problematic behaviours in preschool predict a range of internalizing and externalizing problems in later childhood (Dougherty et al., 2015; Luby et al., 2014; Wichstrøm et al., 2013). There is also evidence that progression of externalizing disorders is more common than with internalizing problems from preschool to school-age (Kerr, Lunkenheimer, & Olson, 2007), however heterotypic continuity of disorders that cross from externalizing problems in preschool to later internalizing problems is also common (Egger & Angold, 2006). It is possible that in these early childhood stages, preschool children are not well equipped to identify and express their internalizing difficulties; it is also possible that internalizing difficulties are present, but not yet recognizable (Lavigne, 1996).

The presence of clinical disorders in preschool populations underscores the importance of having appropriate screening tools to identify young children most at risk. The two most frequently used measures of child behaviours in school-aged populations are the Child Behaviour Checklist (CBCL; Achenbach, 1991) and the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997). Although they are both used globally in research and clinical settings, the SDQ has some advantages over the CBCL for use in preschool populations. First, the SDQ is considerably shorter, with just 25 items compared to the

CBCL's 118 items. In a comparative study of both measures, parents reported an SDQ preference primarily because of its brevity (Goodman & Scott, 1999). Second, the SDQ items were selected based on factor analysis of an expanded version of the Rutter parent questionnaires which yielded five dimensions of child behaviour and were aligned to DSM-IV (APA, 2000) and ICD-10 (WHO, 1993) diagnostic criteria, whereas the CBCL contains some items that are not associated with symptoms. Finally, while all of the items on the CBCL are negatively valenced, several SDQ items are positive valenced, thus child strengths are reported alongside difficulties.

The SDQ is a 25-item child behaviour questionnaire measuring five subtypes of behaviour: conduct problems, hyperactivity, emotional problems, peer problems and prosocial behaviours. The ability of the SDQ to measure intended behaviours consistently across time and groups has been demonstrated in several studies (for a review see Stone, Otten, Engels, Vermulst, & Janssens, 2010). A preschool version of the SDQ, modified to reflect more age appropriate behaviours and contexts has been developed (http://www.sdqinfo.org). To date, 4 cross-sectional studies have addressed the validity and reliability of the preschool version (Doi, Ishihara, & Uchiyama, 2014; Ezpeleta, Granero, La Osa, Penelo, & Domènech, 2013; Klein, Otto, Fuchs, Zenger, & Von Klitzing, 2013; Theunissen, Vogels, de Wolff, & Reijneveld, 2013). While these validation studies have demonstrated that some psychometric properties are comparable to the school-aged version, there are several limitations of these studies. While all studies assess reliability, only two studies additionally address construct validity of the subscales, and other important psychometric properties have not been examined such as external discriminant validity which assesses the similarity of scale items to conceptually unrelated items using alternative validated scales. However the main limitation of existing preschool SDQ validation studies is their cross-sectional design.

Subsequently, examination of psychometric properties over time has not been possible. Particularly, the stability of the factor and measurement structure over time is vital to establish if behavioural constructs are being measured consistently across age groups. Also of key importance for screening tools is the assessment of predictive criterion validity, i.e. their accuracy in identifying children at risk for later psychiatric disorders. This underscores the need for longitudinal analysis of the preschool SDQ.

Summary

Childhood EBDs pose a substantial problem for children's socio-emotional development, psychological adjustment and their economic and health prospects. Externalizing and internalizing problems share several important commonalities, and high levels of comorbidity are likely to be underpinned by shared genetic and environmental factors. Evidence also suggests that identifying and treating problematic child behaviours early is vital to ameliorate symptoms and to improve the likelihood of normative adjustment for children. Research suggests that it is possible to identify problem behaviours in preschool children making this a particularly valuable time to intervene. While screening tools are available to use in preschool populations, longitudinal analysis is required to confirm that behavioural constructs are being measured consistently across the preschool to school-age developmental period, and to assess predictive validity in identifying preschool children at risk of later psychiatric disorders.

Emotional and behavioural problems are influenced by a combination of genetic and environmental factors. Mothers provide 50% of the child's genetic make-up and usually provide the child's rearing environment, therefore the mother is likely to be a particularly important influence in the child's development. In addition, the psychological well-being of the mother is likely to be of great importance for the socio-emotional development and adjustment of children. Therefore examining the relationship between maternal and child

psychopathology is likely to enhance our understanding of emerging EBDs and is likely to highlight mechanisms that might be targeted for interventions.

1.2. Maternal depression

Maternal depression poses an important, global threat to health. The World Health Organization reported the prevalence of common perinatal mental health disorders including maternal depression and anxiety as 13% in high-income countries, rising to 20% in low-income countries (Rahman et al., 2013). A study using a US community sample reported prevalence rates of depression at 8.7% pre-pregnancy with a significant reduction to 6.9% during pregnancy with the highest rates of 10.4% recorded post-partum (Dietz et al., 2007). Moreover, prevalence rates of depression were reported to be higher 4 years after the birth than at any time during the perinatal period (Woolhouse, Gartland, Mensah, & Brown, 2014). Perinatal mental health costs the UK over £8 billion annually. Costs relate primarily to service use and productivity losses. Wider societal costs include quality of life; impact on significant others including enduring consequences for the socio-emotional, behavioural and cognitive development of offspring. Suicide is the leading cause of maternal death during the perinatal period (Bauer et al., 2014).

Several risk factors have been associated with maternal depression. These include: psychosocial factors such as childhood adversity, conflicted interpersonal relationships, low social support, and low life satisfaction, reduced expectations of the infant and adult attachment status; demographic factors such as low SES, and psychiatric risk factors including history of mental health problems and psychiatric comorbidity (Giallo, Cooklin, & Nicholson, 2014; Kingsbury et al., 2014; Luoma, Korhonen, Salmelin, Helminen, &

Tamminen, 2015; van der Waerden, Galéra, Saurel-Cubizolles, Sutter-Dallay, & Melchior, 2015; Warfa, Harper, Nicolais, & Bhui, 2014).

1.2.1. Co-occurring maternal and child psychopathology

The effects of maternal depression on the individual can be painful, enduring and devastating to psychosocial functioning. Depression not only affects the individual, but also those in close personal relationships including intimate partners, family members and offspring. A substantial body of evidence demonstrates that MDM and child psychopathology frequently co-occur in families and that children of depressed mothers are more likely to develop psychopathologies (Brennan et al., 2000; Kim-Cohen et al., 2005; Sellers et al., 2013; Singh & D'Onofrio, 2011).

The psychological well-being of the mother is crucial for understanding normative and dysfunctional socio-emotional development and subsequent adjustment of offspring. Children of depressed mothers have been found to be at increased risk for a range of clinical disorders including childhood depression and anxiety, externalizing disorders including ODD and CD (Harvey & Metcalfe, 2012; Kim-Cohen et al., 2005; Lewis, Rice, Harold, Collishaw, & Thapar, 2011; Whelan, Leibenluft, Stringaris, & Barker, 2015). Children of mothers with persistent moderate or high levels of MDM were more likely to have a range of adjustment problems at age 5, including internalizing, conduct and peer problems (van der Waerden et al., 2015). In a study that assessed MDM and child internalizing and externalizing problems when children were aged 1, 3, 5 and 9 years old, children who were exposed to maternal depressive symptoms at any of the assessments exhibited more internalizing and externalizing behaviours than children who received no exposure to MDM. Exposure to

MDM at more than one assessment increased the likelihood of emotional and behavioural problems in offspring, with those exposed to chronic depression faring worst (Turney, 2012).

The depressive symptoms of mothers can impact child development in utero and manifest in the early months of infancy. Biological factors, such as maternal cortisol (stress) levels effect neurological development in utero and underlie individual differences between infants of depressed and non-depressed mothers (Davis et al., 2007). Neurological deficits identified in infants of depressed mothers include increased arousal, low responsiveness, reduced attentiveness, delayed attention, slower processing and withdrawal (Field, Diego, & Hernandez-Reif, 2009). Neurological dysfunction may underpin maladapted developmental processes crucial for the cognitive, emotional and social development of the infant such as attachment and socialization, self-regulatory processes, and temperament (Chen, Deater-Deckard, & Bell, 2014; Choe, Sameroff, & McDonough, 2013; Kochanska, 1997). Evidence suggests that such maladapted processes increase risk for child psychopathology.

Features of depression, such as comorbidity with other psychopathology and lifetime history of depressive symptoms also influence the relationship between maternal and child psychopathology. A study that examined pure and comorbid forms of psychopathology reported that toddlers of comorbidly depressed mothers were at high risk for attachment insecurity and for internalizing and externalizing problems. However, toddlers of pure depression did not differ from those where the mother experienced no psychopathology. Notably, comorbidity did not increase severity of MDM symptoms (Carter, Garrity-Rokous, Chazan-Cohen, Little, & Briggs-Gowan, 2001). One possibility is that children of comorbidly depressed mothers are at greater risk of later problems because they have inherited a greater genetic vulnerability to psychopathology, i.e. the general p factor (Caspi et al., 2014).

Therefore in order to accurately disentangle the relationship between maternal and child psychopathology, it is important to unpick the relative contribution of genetic factors from the environmental factors associated with parenting.

1.2.2. Evaluating genetic and environmental contributions

The high frequency of co-occurring MDM and childhood EBDs suggests that psychopathology may be transmitted intergenerationally. Because mothers usually provide both genes and a rearing environment, associations between behaviours may have both genetic and environmental origins, and it is likely that both genetic and environmental factors dynamically interact. While psychopathology has been reported to have strong genetic liability, the transmission of psychopathology from mother to child, and changes to child psychopathologies appear to be more strongly associated with environmental processes. Evidence also suggests that the relationship between MDM and child internalizing problems may be different than the relationship between MDM and child externalizing problems. Child age and gender are also likely to influence the magnitude of intergenerational effects. The following brief review of genetically sensitive studies is provided to establish the importance of investigating the intergenerational transmission of psychopathologies and in particular the parenting styles of depressed mothers as a prominent environmental risk for emerging psychopathologies.

Findings from genetically sensitive studies have been synthesized in a recent review which reported that associations between maternal depression and an extensive range of outcomes in childhood including psychiatric disorders as well as internalizing and externalizing disorders were predominantly environmentally mediated (Natsuaki et al., 2014). In this review, studies that isolate environmental and genetic factors, namely adoption and children of twins (CoT)

studies revealed that MDM influenced child psychiatric outcomes including psychopathology and adjustment problems and that this impacts offspring through predominantly environmental pathways, even when controlling for genetic liability.

Genetically informed studies have the potential to reveal important features of the relationship between MDM and child behaviours. One study that used a twin sample to investigate the relationship between maternal and child antisocial behaviour reported that only MDM experienced after the birth of their twins, rather than MDM experienced pre-birth, influenced the child's ASB at age 7. Although this study controlled for comorbidity of antisocial behaviour and depressed mood in mothers as well as prior levels of child antisocial behaviour, genetic liability of psychopathology was reported in the region of 69%, thus approximately one third of the association was explained by unique environmental associations. However, changes in child ASB from age 5 to age 7 were primarily accounted for by non-genetic factors, and a dose response was observed indicating greater ASB problems for children with more exposure to maternal psychopathology (Kim-Cohen et al., 2005).

In another study that used both a CoT and an adoptive sample, genetic and environmental associations between parental depression and child internalizing and externalizing behaviours were examined. In CoT studies, MZ twin mothers share the same genetic similarity with their nieces and nephews as they do with their own children, whereas DZ twin mothers share more genetic similarity with their own children than their nieces and nephews. In this type of design it is possible to disaggregate genetic and environmental contributions to parent and child similarity. Using this sample, correlations between MZ twin mothers indicated that MDM was primarily explained by genetic factors, however the intergenerational transmission

of psychopathology to adolescent offspring was explained by environmental factors. Results from the adoption study which assessed families when children were 4.5, 6 and 7 years old revealed that adoptive mothers' depression did not predict later assessments of internalizing or externalizing problems assessed concurrently, but child behaviours predicted increased adoptive mother depression. Birth mothers' depressive symptoms did however predict both child behaviours with more consistent associations reported for child externalizing behaviour. This suggests a stronger genetic overlap between childhood externalizing behaviours and MDM compared to child internalizing behaviours and MDM (McAdams et al., 2015).

It is possible that child age moderates genetic and environmental associations between MDM and child behaviours. Two other adoption studies, using much younger samples reported that adoptive mothers (AM) depression predicted child behaviours. In one study AM depression measured at 9 months predicted negative responsiveness of the child at 18 months, which predicted (to trend level) maternal depression at 27 months. Child effects were also reported in this study; the negative responsiveness of adopted infants at 18 months predicted increased depressive symptoms in AMs at 27 months, but only if their biological mother (BM) had depression (Roben et al., 2015). In another adoptive study, both BM history of depression and antisocial behaviour predicted internalizing and externalizing behaviours of offspring at 18 months. Notably, AM history of depression and antisocial behaviour also predicted the same child outcomes, indicating a primarily environmental route to transmission of psychopathology. Neither AM nor BM maternal psychopathology were related to change in children's behaviours over the period between 18 and 54 months (Kerr et al., 2013). Age effects were also reported in another study with children having a greater contribution of shared environmental influence to depressive symptoms compared to adolescents for whom genetic effects were stronger (Rice, Harold, & Thapar, 2002).

Gender differences have been reported in studies that examined the intergenerational transmission of psychopathology. Examination of the relationship between maternal depression and child internalizing disorders assessed across childhood with ages ranging from 4 to 13 revealed that daughter depression/anxiety was significantly associated for genetically related and unrelated pairs. However, the same association was only significant for genetically related boys, suggesting that environmental transmission is an additional risk for girls of depressed mothers (Lewis et al., 2011).

Mechanisms that may be implicated in the intergenerational transmission of psychopathology, including parental warmth and hostility were investigated in a genetically sensitive study of parent-child dyads using an assisted conception design. Associations between mother and child depression were fully mediated by maternal warmth and hostility for genetically related dyads. Direct associations were observed between maternal and child depression for genetically unrelated pairs. Parent-to-child hostility mediated associations between parent and child antisocial behaviour, but maternal warmth only mediated the relationship for genetically unrelated pairs (Harold et al., 2011). In another study that assessed the behaviour problems of MZ twins at age 5 and age 7, significant differences were reported in the level of maternal expressed emotion (indicated by maternal negativity and warmth) which predicted differences in their twin's externalizing behaviours. Because these differences were observed in genetically identical twins, the influence of mother's expressed emotions on the child's behaviour was entirely environmental (Caspi et al., 2004).

1.2.3. Maternal depressed mood: an important environmental factor in emerging childhood emotional and behavioural problems

Having established the importance of environmental factors in the relationship between MDM and child psychopathology, disentangling the underlying environmental mechanisms becomes paramount. MDM has been reported to contribute to poorer child outcomes in three key areas: through disruptions to parenting; poorer quality interactions; and conflicted or inadequate rearing environments (Kim-Cohen et al., 2005). These three key areas are reviewed in the following section.

Disruptions to parenting

Numerous studies have sought to identify mechanisms through which maternal depressed mood impacts child psychopathology, with many such studies focusing on factors that result in cognitive, affective and motivational disruptions to parenting. A meta-analytic review of 46 observational studies identified three parenting styles significantly associated with depressed mood: negative parenting characterized by irritability, expressed anger, and coercive behaviour; disengaged, withdrawn and unresponsiveness parenting; and diminished positivity with depressed mothers experiencing fewer pleasurable or enthusiastic interactions (Lovejoy, Graczyk, Hare, & Neuman, 2000). In a review of 152 studies, Dix and Meunier identified 13 regulatory processes that contributed to the disrupted parenting style of depressed mothers including poorer quality time, negative perceptions of self and child, lack of positive feelings, presence of negative feelings, and coercive parenting (Dix & Meunier, 2009).

Negative parenting has been robustly associated with maternal depressive symptoms and subsequent impact on the emotional and behavioural behaviours of children (Dallaire et al.,

2006; Dix & Yan, 2014). A study that examined dimensions of negative and positive parenting reported these two domains to be orthogonal from one another, i.e. they are distinct dimensions rather than opposite ends of the same spectrum. Both low positive and high negative parenting significantly predicted depressive symptoms in the children of depressed mothers, even while controlling for the contribution of the other, although negative parenting appeared to have a stronger impact on child outcomes than a lack of positive parenting (Dallaire et al., 2006). Features of maternal depression influence the mothers ability to parent in a positive way, with those who have a history of severe or chronic depression and those experiencing a current episode of depression being more likely to exhibit negative parenting (Ewell Foster, Garber, & Durlak, 2008).

Evidence suggests that the effect of negative parenting on child behaviours may also be influenced by child factors. A genetically sensitive study used a twin study design to examine the relationship between maternal negativity and aggressive and delinquent behaviours in 6 to 10 year olds. While the significant relationship between MDM and non-aggressive rule-breaking was entirely environmentally mediated, significant associations between MDM and aggression were both genetically and environmentally mediated. Notably, in this study the authors demonstrate that an evocative gene-environment correlation in the relationship between child aggression and maternal negativity, i.e. that genetic factors influence child aggression and it is the expression of this aggression that influences the mothers' increased negativity (Klahr, Klump, & Burt, 2014). Evidence of child characteristics influencing the parenting style of depressed mothers has been reported elsewhere. One such study reported the effects of problematic child behaviour on maternal depression; positive associations were observed between externalizing behaviours of 3 year olds and maternal depression 3 years later; effects which were mediated by family functioning and reduced self-perceptions of

parenting competence (Gartstein & Sheeber, 2004). Parental locus of control was also reported to mediate the relationship between maternal and childhood depression. Subsequently, mothers who felt 'out of control' in relation to their child's internalizing behaviours were more likely to engage in experiential avoidance (Coyne & Thompson, 2011).

Child temperamental characteristics have also been shown to moderate the relationship between MDM and child EBDs. Dimensions of temperament such as effortful control and emotional negativity have been reported to moderate the effects of maternal negativity on problematic child behaviours. Maternal negativity was significantly associated with child adjustment only for children with low effortful control and living in chaotic homes (Chen et al., 2014). Effortful control was found to moderate the relationship between MDM measured at age 3 and externalizing behaviours at age 10 in boys. Boys with low effortful control appeared more vulnerable to the negative effects of MDM at age 3. Additionally, age 3 externalizing behaviours predicted reduced levels of depressive symptoms among mothers of 10 year olds, but only for those high in effortful control (Choe, Olson, & Sameroff, 2014). Another study reported that infants who rated high in emotional negativity were more likely to evoke negative reactions from depressed mothers, and thereby receive greater exposure to negative parenting (Dix & Yan, 2014).

Mother-child interactions

The mother-child relationship plays a critical role in the social, emotional and cognitive development of the child. Early interactions between the primary caregiver and the infant are vital for developing a secure attachment, executive functions including emotional regulation, and socialization (Breaux, Harvey, & Lugo-Candelas, 2013; Wang & Dix, 2013). Maternal

sensitivity has been empirically linked to trajectories of MDM and subsequently to mother-child interactions. In a study that examined trajectories of MDM from 1 month post-partum to 7 years, declining levels of MDM were associated with increased maternal sensitivity and improved quality of observed parent-child play. Subsequently children engaged more in parent-child interactions indicating a transactional interplay between mother and child behaviours. However this transactional pattern of behaviours was not evident for all trajectories of MDM, but high levels of MDM were typically associated with the lowest levels of sensitivity (Campbell, Matestic, von Stauffenberg, Mohan, & Kirchner, 2007).

Children's social development is likely to be an important factor contributing to child emotional and behavioural problems. Associations between MDM and offspring social functioning were reported in one study in which high levels of MDM measured at 1 month post-partum significantly and positively predicted reduced social functioning at 4.5 and 6 years old (Wu, Selig, Roberts, & Steele, 2011). Impaired social functioning is frequently reported in children with disruptive behaviour disorders (B. R. Oliver et al., 2011). In a study that examined social functioning in children aged 2 to 5, aggression at age 2 was the strongest predictor of social dysfunction (Brennan, Shaw, Dishion, & Wilson, 2015). Post-natal depression measured at 21 months predicted reductions in verbal IQ and an increase in both internalizing and externalizing problems at age 7-8 (Barker, Jaffee, Uher, & Maughan, 2011), while language difficulties significantly predicted persistent peer problems from age 7 to age 16, and also predicted an adolescent-onset trajectory of peer problems (Mok, Pickles, Durkin, & Conti-Ramsden, 2014). In another study, peer problems including peer rejection was most pronounced for children with co-occurring internalizing and externalizing problems (Fanti & Henrich, 2010).

Socio-emotional development has been identified as a key differentiator between children of high-functioning depressed mothers and low-functioning depressed mothers. One study examined the relationship between MDM and the language and cognitive development, socio-emotional competence and attachment of children up to 3 years old. The children of high-functioning depressed mothers had better language and cognitive development and socio-emotional competence relative to low-functioning depressed mothers, but experienced more behavioural problems and lower socio-competence compared to children of non-depressed mothers. The parenting skills of low-functioning depressed mothers were more intrusive and withdrawn, and children of low-functioning depressed mothers had less optimal language, cognitive and socio-emotional skills (Wang & Dix, 2013). These finding are consistent with the depression-inhibition hypothesis which posits that children of depressed mothers are more likely to withdraw from interactions, perceive their mother to be less consistent providers of support, and subsequently have greater difficulty regulating their emotions and engaging in social interactions, resulting in poorer socio-emotional competence (Dix, Meunier, Lusk, & Perfect, 2012).

Poorer child rearing environment

The psychological well-being of the mother can impact the caregiving environment provided for the child. While MDM has been associated with less advantageous home environments, comorbid antisocial behaviour may distinguish the more severely affected children. Significant differences have been reported in the home environments provided by depressed mothers with comorbid antisocial behaviour compared to depressed mothers with no comorbid psychopathologies. In one study, mothers with comorbid difficulties had significantly less income (despite comparable education and head of household occupation status), more chaotic homes, and higher rates of conflict with intimate partners including

domestic violence and longer periods of being single. Assortative mating, in which depressed mothers are more likely to have intimate relationships with antisocial men is also likely to have a negative impact on the child's development, particularly if the antisocial mate has provided 50% of their genetic make-up (Jaffee, Belsky, Harrington, Caspi, & Moffitt, 2006). In addition children were exposed to greater levels of parental stress and negative parenting and were more likely to have been removed from the family home (Kim-Cohen, Caspi, Rutter, Tomás, & Moffitt, 2006).

Two important moderating variables that have been robustly examined to understand their impact on the magnitude and direction of effects between mother and child psychopathologies are child age and gender. Child age has been reported to moderate the relationship between MDM and a range of child psychopathologies including internalizing, externalizing, general psychopathy as well as positive and negative affect, with younger children being more vulnerable to adverse outcomes as a result of MDM (Goodman et al., 2011). It has been proposed that children who are exposed to maternal depression early have experienced fewer years of healthy development and are more vulnerable to the negative effects of maternal depression. As they grow older, their dependence on the mother declines with increasing numbers of external relationships (e.g. teachers, peers), and increased cognitive and socio-emotional development, they appear more resilient to the attenuating effects of maternal depression (Goodman & Gotlib, 1999). However age trends were examined, but were not significant in the relationship between MDM and internalizing behaviours (Lewis et al., 2011).

Child gender has also been examined as a moderator of the links between MDM and EBD. Although gender differences have been reported in some studies, others report inconsistent

findings. In a meta-analytic review of 193 studies, MDM was reported to be more strongly related to internalizing problems in girls compared to boys, this was not the case for externalizing problems for which MDM was associated similarly (Goodman et al., 2011). However other findings from studies have not observed gender differences in the relationship between MDM and child EBDs (Bagner et al., 2010; Elgar, McGrath, Waschbusch, Stewart, & Curtis, 2004). Another study reported that while no gender differences were observed in the relationship between MDM and internalizing problems, boys were more vulnerable to the negative effects of maternal depression relative to externalizing problems (e.g. Jaffee & Poulton, 2006).

1.2.4. Reciprocity between mother and child behaviours

While research has more commonly examined the impact of MDM on child internalizing and externalizing problems, over time the importance of the child as agent in the relationship has been realised. Developmental psychopathology research typically examines parent and child contributions to the relationship and emerging psychopathologies using a transactional framework in which both parties are active agents. Reciprocity is one system through which parents and children influence one another situationally and over time. Parent-child interactions occur within the context of the parent-child relationship, which is itself imbued with histories of previous interactions and future expectations (Loulis & Kuczynski, 1997). The quality of the relationship and the interactions may therefore mutually influence one another in a transactional and reciprocal way.

Maternal influences on maladapted development can begin in-utero. Biological factors associated with poorer neurological development of foetal executive functioning and self-regulatory systems can impact infant attachment and socialization processes post-partum

(Choe, Sameroff, & McDonough, 2013; Field, Diego, & Hernandez-Reif, 2009). Adequate parental responsiveness is a principal component of socialization processes which require that parents and infants develop a 'system of reciprocity' (Kochanska, 1997). Optimal maternal responsiveness fosters increased compliance in children and reduced parental coerciveness as well as the internalization of parental values and goals however problematic behaviours can begin to emerge where parental responsiveness is less than optimal (Kochanska & Kim, 2013; Schueler & Prinz, 2013).

The 'depression-inhibition hypothesis' (Dix et al., 2012) proposes that mother-infant communication can be inhibited by mutual withdrawal. Depressed mothers who withdraw from communication with their infants, are more likely to have infants that withdraw from interactions with the mother, with detrimental consequences for the infants social development (Dix et al., 2012; Wang & Dix, 2013). Parent effects indicate that the mother's behaviour predicts later child outcomes, while child effects indicate that the child's behaviour predicts subsequent maternal behaviours. Parent effects were consistently observed in a study that examined reciprocity in maternal depression and child withdrawal and mutual responsiveness. Maternal depression predicted later child withdrawal at each assessment from age 2 to age 7 and at age 4.5 MDM directly predicted age 7 externalizing behaviours and indirectly predicted social competence via withdrawal at age 7. Child effects were considerably less frequent and only indirectly predicted social competence and externalizing behaviours via mutual responsiveness, suggesting that maternal depression contributes more substantially to negative transactional trajectories (Yan & Dix, 2013).

Understanding how disruptive children negatively impact parenting behaviours has the potential for elucidating mechanisms by which maladaptive behaviours emerge and

perpetuate. Patterson's 'coercion model' specifies a reciprocal mechanism through which externalizing behaviours emerge and persist (Patterson, 1982). Here, the behaviour of one member of the dyad negatively influences the behaviours of the other. Specifically, behaviours relate to parent's attempts to control the child's externalizing behaviours with harsh discipline. The principles of the coercion model include reaction to aversive stimuli (e.g. child or mother directive) with non-compliance. Parent attempts to control the child's behaviour using increasingly harsh disciplinary strategies resulted in increasingly aversive child behaviours. Negative behaviours are positively reinforced with parental (withdrawn directive) and child (problem behaviours) capitulation. Parents that inadvertently reinforce oppositional behaviour through parental withdrawal from the directive, may enable children persist in this behavioural manner. This exemplifies a transactional mechanism which has been replicated in several studies (Burke, Pardini, & Loeber, 2008; Eddy, Leve, & Fagot, 2001; Hipwell et al., 2008).

Reciprocity between parent and child is evidenced by bidirectional effects across behaviours measured over multiple time-points. Associations between maternal and child psychopathologies have been extensively researched, however relatively few studies have examined reciprocity between depressed mothers and disruptive behaviours across childhood. Notably, such studies predominantly use US samples, several of which comprise low-income families, or focus solely on boys. The presence of bidirectional effects and the frequency with which they are observed across study periods has been inconsistent. Associations between MDM and different forms of child psychopathology may manifest differentially to dimensions of child behaviours. In such cases, it is possible that these different associations represent different pathways to disorders. A nascent literature has reported reciprocity

between maternal depression and several facets of child behaviour, highlighting the need for further research to aid consolidation and generalizability of findings to date.

Maternal depressed mood and externalizing behaviours

Four studies have explored reciprocity between maternal depressed mood and oppositional and irritable dimensions within the Oppositional Defiance Disorder (ODD) symptom area (Burke et al., 2014). These sub-dimensions of ODD may be differentially related to MDM. The overall pattern of results from these studies has largely supported reciprocity between MDM and oppositionality, irritability and non-compliance. Using a community sample, bidirectional effects were reported between maternal depressed mood and oppositional behaviour from age 2 to 5. MDM measured at age 2 and 4 predicted increased oppositionality one year later, while oppositionality measured at age 2 and age 3 predicted elevated depressive symptoms one year later (Choe, Shaw, Brennan, Dishion, & Wilson, 2014). Age 2 non-compliance, but not irritability, predicted membership of a moderate-high maternal depression trajectory group which subsequently predicted adolescent externalizing problems (Gross, Shaw, Burwell, & Nagin, 2009). However, irritability did demonstrate bidirectionality with maternal depression from age 1 to 9; child irritability at age 3 and 5 predicted maternal depression at age 5 and 9 (odds ratio = 1.47 and 1.28 respectively) while depression at age 1 and 3 predicted increased irritability at ages 3 (B=.44) and 5 (B=.33) (Wiggins, Mitchell, Stringaris, & Leibenluft, 2014). Additionally, a broader ODD outcome measure that encompassed irritability symptoms from age 3 to 6 predicted increased maternal depression symptoms, and vice versa (Harvey & Metcalfe, 2012).

Evidence from studies of reciprocal relationships between MDM and disruptive child behaviours has also been inconsistent. Using a sample of mother-son dyads from 310 low-

income families, reciprocity between MDM and childhood aggression (Gross, Shaw, & Moilanen, 2008) and externalizing behaviours (Shaw, Gross, & Moilanen, 2009) was examined. Gross and colleagues reported significant child and parent effects from age 5 to age 6 (but not from age 6 to 10), while Shaw and colleagues reported 5 significant parent effects compared to 2 significant child effects. Another study reported no child effects alongside parent effects that were negatively associated with girls' delinquency (Steele, Rasbash, & Jenkins, 2013). Conversely, other studies reported consistently observed effects across assessments of MDM and externalizing behaviours from age 2 to 9 (Miner & Clarke-Stewart, 2008); hyperactivity and conduct problems from age 4 to 11 (Elgar, Curtis, McGrath, Waschbusch, & Stewart, 2003); girls' antisocial behaviour from age 5 to 11 (Jaffee & Poulton, 2006); and behaviour problems from age 4 to 7; parent and child effects were reported as equal across time and across gender (Bagner, Pettit, Lewinsohn, Seeley, & Jaccard, 2013).

Maternal depressed mood and internalizing behaviours

Only three studies explicitly examine reciprocity of maternal mood with child internalizing behaviours, each in addition to observing externalizing behaviours during childhood. In each, bidirectional effects were observed between MDM and both domains of child behaviours, with parent effects appearing to exert a stronger influence than the child in the reciprocal relationship. In the first such study, Elgar and colleagues observed reciprocity between maternal depression and child emotional problems as well as hyperactivity and conduct problems over a four year period using a large community sample. Consistently significant bidirectional effects between all constructs at each time point were observed and no gender differences were reported. Further analysis revealed stronger parent effects for externalizing

behaviours in contrast to stronger child effects for internalizing behaviours (Elgar et al., 2003).

Jaffee and Poulton (2006) examined reciprocity between maternal depressed mood and child measures of antisocial and anxious/depressed behaviour. Gender differences were not observed in the relation between maternal and child internalizing behaviours. Parent effects were reported across three time points from age 5 to 11, while child effects were only present at one, from age 5 to 7. Conversely, gender differences were observed in the relationship between maternal mood and antisocial behaviours; only parent effect were observed for boys and were reported consistently across the study period, while a reciprocal model demonstrated parent and child effects for girls that were equal in magnitude (Jaffee & Poulton, 2006). Finally, Nicholson examined the relationship between depressed mood and problematic behaviour in a high risk sample of US teenage mothers and their first born children studied from age 3 to 10 years. Bidirectional effects were reported between mother behaviour and child internalizing and externalizing behaviour; gender differences were not explored. Notably, parent effects were reported as more important in the transactional relationship (Nicholson, Deboeck, Farris, Boker, & Borkowski, 2011).

This evidence supports the interdependence of maladapted mother and child behaviours across childhood. Research indicates that both mother and child present a risk for one another, with MDM eliciting several negative outcomes for children, while childhood EBDs have been shown to maintain maternal psychopathologies. However, understanding the nature of how these two trajectories influence one another is likely to enhance our understanding of the complex nature of their interdependence.

1.2.5 Changing behaviours over time

Change occurs rapidly across childhood. Physical growth occurs alongside cognitive, social and emotional development, thus as children become increasingly physically independent, they also develop psychological independence from primary caregivers. At school, relationships with teachers and peers increase children's sphere of influence. Accurately assessing how children's behaviours change across childhood, in conjunction with ongoing physical, cognitive, social and emotional development is important for understanding factors associated with change, and for identifying malleable mechanisms that may be targeted by interventions.

In longitudinal research, examining quantitative change in behaviours across a period of time is possible with repeated measures of behaviours. Repeated measures have an intrinsic temporal precedent, i.e. each subsequent assessment occurs at a later occasion than the previous, however, fitting latent growth factors to repeated measures enables estimation of individual developmental trajectory in terms of starting point and pattern of change over time (Preacher, Wichman, MacCallum, & Briggs, 2008; Willett & Singer, 2003). Multiple behaviours can be modelled together using this technique to establish how changes in different behaviours is related over time. This method can advance our understanding of how behaviours develop in unison by allowing change in behaviour to predict outcomes.

While this methodological approach offers many advantages to investigating how behaviours emerge together over time, it has rarely been used to address change in maternal and child psychopathology across childhood. Studies have examined the influence of predictors on change, for example history of MDM was reported to predict initial levels and change in the depressive symptoms of 11 year olds (Garber & Cole, 2010). However studies that explicitly

examine how observed change in one behaviour relates to observed change in another are relatively rare. One such study that examined MDM and oppositional behaviour from age 2 to age 5 reported an expected correlation between initial levels of mother and child behaviours; thus children with high initial levels of oppositional behaviour had mothers with high initial levels of MDM. Both behaviours decreased linearly across the period and change over time in oppositional behaviour was not significantly related to change over time in MDM (Choe et al., 2014). In another study, parallel process growth models were estimated to assess the interrelatedness of the depressed mood of mothers and the aggressive behaviours of their sons from age 5 to age 10 in a sample of low-income families. High initial levels of MDM were significantly and positively related to intial levels and change in child behaviours indicating that mothers high in depressive symptoms had sons with high levels of aggressive behaviour, and that reductions in their son's aggressive behaviours was slower. Correlations between linear slope growth factors further indicated that change in MDM over time was significantly and positively related to change in child aggressive behaviours over time, indicating that MDM declined more steeply in the mothers of boys whose aggressive behaviour also declined more steeply (Gross et al., 2008).

Change in MDM and externalizing behaviours was examined using a sample of children aged from 1 to 9 years. In a multilevel model, MDM predicted absolute rates of child externalizing behaviours at age 9, as well as change in externalizing behaviours from 1 to 9 years indicating that higher levels of MDM predicted faster increases in problem behaviour over time. Moreover, MDM was also significantly associated with variablitity in child scores. Changes in MDM over the period were also examined as a predictor of change in externalizing problems. Incremental changes in MDM were significantly and positively related to the externalizing behaviours of children with avoidant-insecure attachment, but

were not associated with change in securely or disorganized-insecurely attached children .No gender differences in the relationship between chanage in mother or child behaviours were observed (Munson, McMahon, & Spieker, 2001). One other study that examined change in MDM and disruptive behaviours from age 3 to age 6 reported declines in both behaviours over the period. However, in this study, change in mother and child behaviours over time was not explicitly examined, i.e. the authors did not report if the declining rates of MDM and disruptive behaviours were correlated (Spieker, Larson, Lewis, Keller, & Gilchrist, 1999).

Research to date has precluded any empirical examination of how change in MDM and internalizing behaviours are related over childhood. One study which has examined change in internalizing behaviours and mother-child conflict reported that change was not significantly related from age 2 to age 4 (Weaver, Shaw, Crossan, Dishion, & Wilson, 2014). This highlights an important area of research that is unexplored, and which has potential to yield valuable insights with clinical implications. Identifying if change in internalizing behaviours and MDM are interdependent over time is an important next step to understanding how maternal and child psychopathologies emerge together.

Evidence to date suggests that the relationship between MDM and externalizing and internalizing problems is complex, dynamic and interdependent. Unpicking the contribution of MDM to both domains of child behaviour, and the contribution of child behaviours to change in MDM may indicate quantitative differences in the relationship between MDM and broad domains of child behaviour. Elucidating if mother and child behaviours influence change in one another over time also has the potential to inform and focus interventions and treatments of both child and mother psychopathologies.

Summary

The evidence reported here points to several mechanisms that underlie the complex relationship between MDM and childhood emotional and behavioural problems. Although maternal depression appears to be heritable, the intergenerational transmission of psychopathological symptoms is likely to have an environmental component. MDM influences child behaviours through mechanisms that disrupt parenting and the socio-emotional and cognitive development of the child. Child factors relating to temperament have also been implicated in the relationship between psychopathologies. Associations between MDM and child EBDs may be moderated by child age and gender, although the evidence for this has been somewhat inconsistent. Reciprocity of behaviours within the context of the mother-child relationship has the potential to elucidate how MDM and both internalizing and externalizing behaviours interact across childhood. While evidence suggests that change in MDM and externalizing behaviours are significantly related over time, change in MDM and internalizing behaviours is yet to be empirically examined. Understanding how mother and child psychopathologies unfold together across childhood is vital to identify areas that can be targeted for interventions.

1.3. Rationale and research questions

Thus far this chapter has summarized an extant literature regarding the development of child psychopathology, genetic and environmental risk factors, comorbidity of disorders, the impact of maternal psychopathology on developing EBDs, and the reciprocal influence of child EBDs on MDM. Understanding how maternal depression and childhood emotional and behavioural difficulties emerge and perpetuate in unison during childhood is important for

developing treatment and prevention strategies to ameliorate individual difficulties and address wider social concerns associated with poor mental health and antisocial behaviours.

Epidemiological research aims to understand the development of pathologies using large population samples to identify biological, psychological and social correlates. Addressing questions about the interdependence of mother and child psychopathologies requires familial samples that are generally representative of the population of interest. A general population sample will include an extensive range of individual differences in maternal and child psychopathologies. Moreover, longitudinal cohort data will provide repeated measures of interest over several years.

The Millennium Cohort Study charts the development of over 19,000 families across the UK. Maternal depressed mood was measured alongside the SDQ when children were aged 3, 5, 7, and 11. Child behaviours were measured at age 3 using a modified version of the SDQ intended to reflect more age appropriate contexts. Existing validations of the preschool SDQ are limited, not only in number, but also by their cross-sectional designs that limit longitudinal examination of psychometric properties across the preschool to school-age developmental stages. With evidence suggesting that the relationship between MDM and child EBDs begins early in childhood, it is vital that the measure used to determine child behaviours at age 3 are valid and reliable relative to the standard version. Therefore a prerequisite stage of analysis will be to validate the preschool SDQ in conjunction with the later measures of the SDQ (Chapter 2). A thorough validation of the preschool SDQ measure examines the critical psychometric properties of measurement invariance across time and gender, as well as predictive validity to identify preschool children at risk of later clinical disorders.

The available repeated measures of maternal depressed mood and child behaviours were used throughout the thesis to address two fundamental questions about the interdependence of mother and child psychopathologies. First, bidirectionality is examined in the mother-child relationship to understand an important mechanism that has the potential to perpetuate maladjusted relationships – reciprocity. Specifically, analysis will examine whether MDM relates differentially to externalizing versus internalizing behaviours; whether one member of the dyad has a stronger contribution to the relationship than the other; and whether the reciprocal relationship differs for sons or daughters (Chapter 3). Second, the repeated measures of MDM and child behaviours provide an opportunity to assess how the individual behaviours change over time. Latent growth curve modelling techniques will be used to estimate features of change, including direction, rate, and shape of change. Multivariate LGC analysis will be used to examine if change in one behaviour significantly influences change in the other over time (Chapter 4). Finally, a general discussion will summarize the main findings within a developmental psychopathology framework. The practical and clinical implications of these studies will be highlighted, as well as methodological and practical limitations and suggested directions for future research (Chapter 5).

Chapter 2: Validity of the Preschool Strengths and Difficulties Questionnaire

2.1 Introduction

This thesis addresses the relationship between maternal depressed mood (MDM) and childhood emotional and behavioural disorders (EBDs). The relationship begins early with evidence that childhood EBDs emerge early with childhood-onset representing the most severe and persistent cases (Frick & Viding, 2009; Luby et al., 2014) highlighting the importance of early identification. Prevalence rates of EBDs in preschool are comparable with those in school-aged children, thus having appropriate screening tools for this population is vital. Angold and Egger (2007) suggest that "the overall 'architecture' of the common forms of child and adolescent psychopathology is already in place by the preschool years" (Angold & Egger, 2007, p.962).

The Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997) is a brief child behaviour questionnaire that assesses dimensions of child relating to externalizing (conduct problems and hyperactivity), internalizing (emotional and peer problems) and prosocial behaviours. A preschool version has been adapted to reflect more age-appropriate contexts and behaviours appropriate for use with 3 to 4 year olds (www.sdqinfo.org). The validity of the preschool SDQ has rarely been examined, of the limited number of studies which have explored its psychometric properties, none have used longitudinal data thus examination of the stability of the measurement scale over time (i.e. measurement invariance), and predictive validity have not yet been established.

Psychometric properties of behaviour measurement scales indicate how well the items and subscales measure intended behaviours consistently across time and groups. Internal consistency reliability of subscales can be tested to assess the consistency with which related items are selected. This can be achieved by examining the extent to which factor items are interrelated (Cronbach's alpha) or the proportion of the subscale measuring construct (McDonald's omega). Evidence suggests that McDonald's omega provides a more accurate measure of internal consistency reliability (Stone et al., 2013). There are several means by which the validity of the SDQ can be assessed. Construct validity indicates the ability of a measurement scale to detect intended constructs. The properties of convergent validity demonstrates item selection concordance with pre-existing, validated measures of conceptually-related behaviours, and conversely item selection that is incongruent with theoretically different constructs demonstrates discriminant validity. Finally, the ability to predict 'real-world' outcomes such as clinical disorder diagnoses indicates criterion validity.

This Chapter will evaluate the psychometric properties of the adapted preschool SDQ. This is the first such validation study to use longitudinal data to assess the reliability and validity of the measures across the preschool to school-age developmental period. First the factor structure of the measure will be examined. Additional psychometric assessments include reliability; measurement invariance over time; construct, convergent and discriminant validity; and finally predictive validity over 2 and 4 year periods.

2.1.1 Validity of the school-age SDQ

Psychometric studies of the SDQ using school-aged children typically confirm the intended 5 factor structure (Goodman, 2001; Matsuishi et al., 2008; Smedje, Broman, Hetta, & Von Knorring, 1999). An alternative 3 factor model, consisting of externalizing (incorporating

conduct problems and hyperactivity), internalizing (emotional and peer problems) and prosocial factors has also been proposed (Dickey & Blumberg, 2004). This 3 factor structure has been validated using school-age samples (Goodman, Lamping, & Ploubidis, 2010).

Several aspects of validity have been examined using the school-age SDQ. First, to demonstrate satisfactory internal convergent validity, items designed to measure a specific construct should be highly correlated with one another. Niclasen et al. (2013) reported the average variance explained (AVE) statistic i.e. the mean r-squared value across the set of indicators measuring their respective factor, which indicated satisfactory internal convergent validity of SDQ subscales. For a subsample of 10-12 year olds, AVE scores across the 5 subscales ranged from .44 to .62, with all but the prosocial subscale exceeding the .50 cut-off indicating satisfactory internal convergent validity (Fornell & Larcker, 1981). However for 5 to 7 year olds equivalent scores ranged from .38 to .55 with 4 subscales falling below .50, suggesting weaker internal convergent validity for younger samples.

Second, associations with other conceptually-related measures of child psychopathology have been explored to assess external convergent validity. A review of SDQ validation studies presented weighted average correlations between SDQ subscales and equivalent Child Behaviour Checklist subscales (CBCL; Achenbach, 1991) from 9 parent-reported studies of 4 to 12 year olds. Coefficients between SDQ and CBCL subscales were uniformly strong and positive, specifically: conduct problems and externalizing (mean: r = .71, range: .60 - .84); hyperactivity and attention problems (mean r = .69, range: .64 - .78); emotional problems and internalizing (mean r = .64, range: .44 - .77); and finally peer problems and social problems (mean r = .52, range: .41 - .75) subscales (Stone et al., 2010). External discriminant validity has been investigated using multitrait-multimethod (MTMM) approaches. This technique

employs a correlation matrix of SDQ subscales rated by multiple informants (i.e. parent and teacher). Within-trait across-rater (i.e. convergent) correlations should be higher than across-trait across-rater (i.e. discriminant) correlations. Two studies that used this method with school-aged populations reported poorer discriminant validity between externalizing and prosocial factors compared to internalizing subscales which demonstrated satisfactory convergent validity (Goodman et al., 2010; Hill & Hughes, 2008).

The validity of the school age SDQ is further supported by evidence of its relatedness to 'real-world' or criterion outcomes such as clinical disorder diagnoses measured at the same time (concurrent) or subsequently (predictive). Concurrent criterion validity was demonstrated in UK and Bangladeshi populations using SDQ scores to identify individuals with behavioural and emotional disorders (R Goodman, Renfrew, & Mullick, 2000). Agreement between SDQ prediction and clinical diagnosis, measured using Kendall's tau, ranged from τ = .50 - .68 (conduct disorder), τ = .49 - .67 (hyperkinesis) and τ = .55 - .73 (emotional disorder). Russell, Rodgers and Ford (2013) reported the area under the receiver operator curve (ROC) to quantify screening accuracy, presenting high levels of agreement between SDQ scores and diagnoses of Attention Deficit Hyperactivity Disorder (ADHD; ROC = .94) and Autism Spectrum Disorder/Asperger Syndrome (ASD/AS; ROC = .90).

Predictive criterion validity of the SDQ was demonstrated for school-aged UK children. Goodman et al (2010) used parent-reported SDQ scores to predict developmental outcomes 3 years later. They reported SDQ conduct problems subscale scores as strong predictors of any behavioural diagnosis (Odds Ratio = 1.65 for a 1-point increase on the SDQ conduct problem subscale), ADHD (OR = 1.33) and ASD (OR = 0.65). Similarly, the emotional problems subscale predicted later emotional disorder (OR = 1.32) and ASD (OR = 1.25); hyperactivity

predicted later ADHD (OR = 1.78) and ASD (OR = 1.42) while prosocial (reverse scored) and peer problem subscales predicted ASD (OR = 1.84 and 1.58 respectively) and ADHD (OR = 0.88 and 1.29).

Assessing the stability of the SDQ measurement structure across time is a crucial step towards establishing that constructs are measured consistently at each age. However, this property has rarely been examined using the parent-reported SDQ. Confirmatory factor analysis (CFA) was used to demonstrate metric invariance, i.e. factor loadings were invariant across 11 to 14 and 15 to 17 year old age groups as reported by grandparents (Palmieri & Smith, 2007); and strong invariance, i.e. factor loadings and thresholds were invariant across 11 to 13 and 14 to 16 year old age groups (He, Burstein, Schmitz, & Merikangas, 2013).

The internal consistency of SDQ subscales has been widely reported, though often falling below the level usually accepted as satisfactory (i.e. Cronbach's alpha > .70; Kline, 2005). Stone et al (2010) reported weighted mean alpha coefficients extracted from 26 validation studies: for conduct problems (mean: $\alpha = .58$, range: .46 - .76), hyperactivity (mean: $\alpha = .76$, range: .58 - .85), emotional problems (mean: $\alpha = .66$, range: .60 - .76), peer problems (mean: $\alpha = .53$, range: .30 - .76) and prosocial (mean: $\alpha = .67$, range: .54 - .84). McDonald's omega, which estimates the proportion of a scale measuring a construct, typically yields higher reliability estimates, but has rarely been used to assess reliability of the SDQ. A comparative study reported higher omega coefficients ($.74 < \omega < .91$) compared to alpha coefficients ($.54 < \alpha < .82$) for the school-age SDQ (Stone et al., 2013).

2.1.2 Validity of the preschool SDQ

While the SDQ's validity has been extensively studied in school-aged populations (Goodman et al., 2010; Goodman, 2001; Stone et al., 2010) its validity in preschool children has rarely been addressed. Childhood EBDs are evident in preschool populations and are as prevalent in this age group as they are in school-aged children (Egger & Angold, 2006). Early onset of EBDs is synonymous with increased severity of symptoms across the life course (Egger & Angold, 2006; Luby et al., 2014) making preschool an optimal time to screen for child psychopathology. Therefore it is imperative to assess the psychometric properties of the preschool SDQ.

To date 4 studies have addressed the SDQ scale validity and reliability using preschool populations. All preschool studies support a 5 factor configuration (Doi et al., 2014; Ezpeleta et al., 2013; Klein et al., 2013; Theunissen et al., 2013). Internal reliability ranged from $.58 < \alpha < .79$ (Germany), $.50 < \alpha < .74$ (Netherlands) and $.45 < \alpha < .70$ (Japan) where Cronbach's alpha coefficients were reported but was higher $.67 < \omega < .82$ (Spain) when omega coefficients were reported.

The Spanish and Dutch studies also examined external convergent and concurrent criterion validity. External convergent validity was demonstrated through correlations between SDQ subscales and the CBCL internalizing and externalizing subscales. Correlations between the SDQ and equivalent CBCL internalizing subscales ranged from $.17 < r < .48$ and $.28 < r < .45$ (Spain and Netherlands respectively) and for externalizing subscales ranged from $.19 < r < .52$ and $.22 < r < .64$. The screening accuracy of the preschool SDQ to identify children with behavioural and emotional disorders supported concurrent criterion validity. Additionally, an SDQ total difficulties score (sum of hyperactivity, conduct, emotional and peer problem

scores) predicted the criteria 'treatment status' (Netherlands) and 'presence of any disorder' (Spain).

A key limitation of the preschool validation studies is their cross-sectional designs, which prohibits examination of the stability of the factor and measurement structure over time and of predictive criterion validity. Moreover, the internal convergent and external discriminant validity of the preschool SDQ have yet to be evaluated. The current study examined the psychometric properties of the parent-reported preschool SDQ using longitudinal data collected when children were aged 3 (preschool SDQ), in conjunction with standard SDQ responses at ages 5 and 7. The critical property of predictive criterion validity was assessed using age 5 outcomes of mother-reported diagnosis of ADHD and ASD/AS and a teacher-rated measure of personal, social and emotional development.

2.2 Method

2.2.1 Sample

The Millennium Cohort Study (MCS) is a UK longitudinal study of children born between September 2000 and August 2001. This article uses 3 waves of data collected when children were approximately 3, 5 and 7 years old. At age 3, 19,942 families were sampled, 15,590 responded to at least one part of the MCS (response rate: 78%), and 14,444 completed the SDQ (mean child age at data collection = 3.15 years, age range: 2.65 - 4.57). At age 5, 19,184 families were sampled, 15,246 responded (79%), and 14,615 had SDQ data, (mean = 5.22, range: 4.40 - 6.13). At age 7, 17,031 families were sampled, 13,857 responded (81%), and 13,358 had SDQ data (mean = 7.24, range: 6.34 - 8.15). Only one child from each of 246 families containing multiple births was included. Observations collected when children were

more than a year older or younger than the intended study age were excluded. Our final analysis sample consisted of 42,417 observations from 16,659 distinct children (48% male) for whom we had SDQ scores on at least one occasion. MCS sampling was stratified to over-sample children living in socio-economic deprivation and poverty, and in ethnically diverse areas. Sampling weights were provided to adjust for over-sampling relative to UK demographic characteristics, attrition and non-response (Jones & Ketende, 2010).

Participant attrition is a common problem when using longitudinal data. Attrition was reported in the MCS from wave 1 to wave 2 for three reasons: relocated families could not be traced, families could not be reached, and refusal (Plewis, 2007). Analysis of participant attrition or non-response has been reported elsewhere; factors including maternal education, ethnicity and maternal health have been reported to predict non-response from wave 1 to wave 2 (Plewis, 2007).

Although in the current study sampling weights were applied to account for non-response, attrition across the three waves of data was analysed to determine if mothers who experienced depressed mood at a previous wave, predicted non-response at the following wave. Chi-square analysis revealed that maternal depressed mood (MDM) when children were aged 3 predicted maternal non-response for age 5 SDQ measures (odds ratio = 1.071, $p<.0001$), and that age 5 MDM predicted non-response of age 7 SDQ measures (OR = 1.048*). In addition, mother-rated SDQ total difficulties score (sum of conduct, hyperactivity, emotional and peer problem scores) also predicted SDQ non-response at subsequent assessments. Thus age 3 total difficulties predicted age 5 SDQ non-response (OR = 1.06, $p<.0001$) and age 5 total difficulties predicted age 7 non-response (OR = 1.06, $p<.0001$).

Ethical approval was provided by the NHS Research Ethics Committee. Informed parental consent was obtained alongside written parental consent to access family health, educational and economic records. At age 7 children also provided oral assent.

2.2.2 Measures

SDQ measures

The parent-report SDQ contains 25 items forming 4 difficulties subscales - conduct problems, hyperactivity, emotional problems, peer problems - and a prosocial subscale. The preschool version (administered at age 3) and standard version (age 5 and age 7) were utilised. In the preschool version (www.sdqinfo.org), three items are adjusted to reflect age-appropriate behaviours and contexts. Specifically, '*argumentative with adults'* and *'can be spiteful'* replace '*often lies or cheats'* and *'steals from home, school or elsewhere'* (conduct problems subscale), and *'can stop and think before acting'* replaces *'thinks things out before acting'* (hyperactivity subscale). Parents rated statements as either 0 (not true), 1 (somewhat true), or 2 (certainly true).

Criterion outcome measures

When the children were aged 5, their parents were asked whether a health professional had ever diagnosed the child with ADHD and ASD/AS. Medical records were not consulted. Prevalence rates were 0.9% for ADHD and 0.9% for ASD/AS (0.2% for comorbid disorders).

Personal, social and emotional development (PSE, a subscale of the Foundation Stage Profile) was rated by teachers for children aged 4 to 5 (www.education.gov.uk/eyfs). The scale contains 27 dichotomous items that measure dispositions and attitudes, e.g. '*maintains attention and concentrates*', social development, e.g. '*plays alongside others*' and emotional development, e.g. '*separates from main carer with support'.* The internal reliability of this scale in MCS was $\alpha = .91$.

2.2.3 Analysis

Analyses of the preschool SDQ comprised five stages that assessed: internal factor structure; internal reliability; measurement stability over time (measurement invariance); construct validity by examining AVE scores and factor correlations across time; and finally predictive criterion validity over 2 years.

First, the internal factor structure of the preschool SDQ was examined using CFA. The established 5 factor model was compared against the alternative 3 factor model of externalizing (conduct problems and hyperactivity subscales), internalizing (emotional and peer problems subscales) and prosocial factors (Dickey & Blumberg, 2004), and a 1 factor model (Harman's single factor test). In each model, factor loadings and thresholds were free to vary across the three time points, with only item-factor configuration fixed equal (configural invariance). Second, two internal reliability measures, Cronbach's alpha (inter-relatedness of subscale items) and McDonald's omega (proportion of subscale measuring construct), were calculated for each subscale within an SEM framework that accounts for the ordinal nature of item response distributions. Equality of coefficients across time was assessed using bootstrapped confidence intervals with 1000 replications (Maydeu-Olivares, Coffman, García-Forero, & Gallardo-Pujol, 2010).

Third, the robustness of the measurement model across time, i.e. measurement invariance was tested. The best configural invariance model from the first stage of analyses provided a baseline. Each subscale was tested independently: factor loadings (metric invariance), then thresholds (scalar invariance) were fixed to be equal across time[1]. Increasing degrees of measurement invariance were demonstrated if model fit was not reduced by adding constraints, i.e. items and factors were consistent across time. Where model fit was significantly reduced by constraining all items loading onto a factor, invariance of each item was assessed separately to identify invariant items. Partial invariance was demonstrated when some, but not all of the items associated with a factor demonstrated invariance across time. To determine the best fitting measurement model for each subscale, invariant factor loadings and invariant thresholds were constrained simultaneously (strong invariance). Having examined subscales individually, in the final stage, all subscales were then tested together, implementing constraints based on the results of independent subscale testing, to establish the best fitting model for the entire SDQ.

Fourth, construct validity was evaluated. AVE scores represent the average amount of variance explained in items loading on to their respective factors. Factors with AVE scores exceeding .50 demonstrate satisfactory internal convergent validity. Those factors with AVE scores exceeding their highest squared correlation with another factor achieve adequate external discriminant validity (Fornell & Larcker, 1981). The effectiveness of the three adapted items unique to the preschool SDQ were examined using item r^2 values indicating the amount of variance in the item explained by the associated factor. A CFA model where factor

[1] The three amended preschool items were not fixed to be equal during measurement invariance testing.

loadings of the three items were free to vary across time was compared to one in which they were constrained.

Finally we assessed the predictive validity of the preschool SDQ. External convergent validity was examined using correlations between the preschool and school-age SDQ scores. Probit or linear regression analysis were used to test the predictive criterion validity of the preschool SDQ in detecting age 5 binary outcomes of ADHD, ASD/AS and a continuous measure of PSE respectively. Probit regression coefficients range from -1 to 1 with a one point increase in the predictor equating to an increase in the z-score (standard deviations above the mean) at the magnitude of the regression coefficient.

Mplus7.11 was used for all analyses (Muthén & Muthén, 1998-2012). SDQ items were treated as ordinal. Sampling weights were applied to improve representativeness of the UK population, and the weighted least-squares means and variance adjusted (WLSMV) estimator used (Muthén & Muthén, 1998-2012). Due to the categorical nature of our data, we used a chi-square difference test to compare the increasingly constrained nested models. Given the propensity of the model chi-square statistic to reject good models when samples are large and/or models complex, we used the comparative fit index (CFI) and the root mean square error of approximation (RMSEA) to assess model fit. Model fit was considered adequate where CFI values exceeded .95 and RMSEA values fell below .06 (Hu & Bentler, 1999). For testing competing models we followed Cheung and Rensvold's (2002) suggestion for comparison tests in very large samples, specifically that the more parsimonious model is superior when the increase in CFI offered by the more complex model is $\leq +0.01$. Given the high power achieved with our large sample size, the relative and practical importance of

model parameters were assessed using the $p < .0005$ significance level. Effect sizes and 99.95% confidence intervals are reported where appropriate.

2.3 Results

2.3.1 Internal factor structure

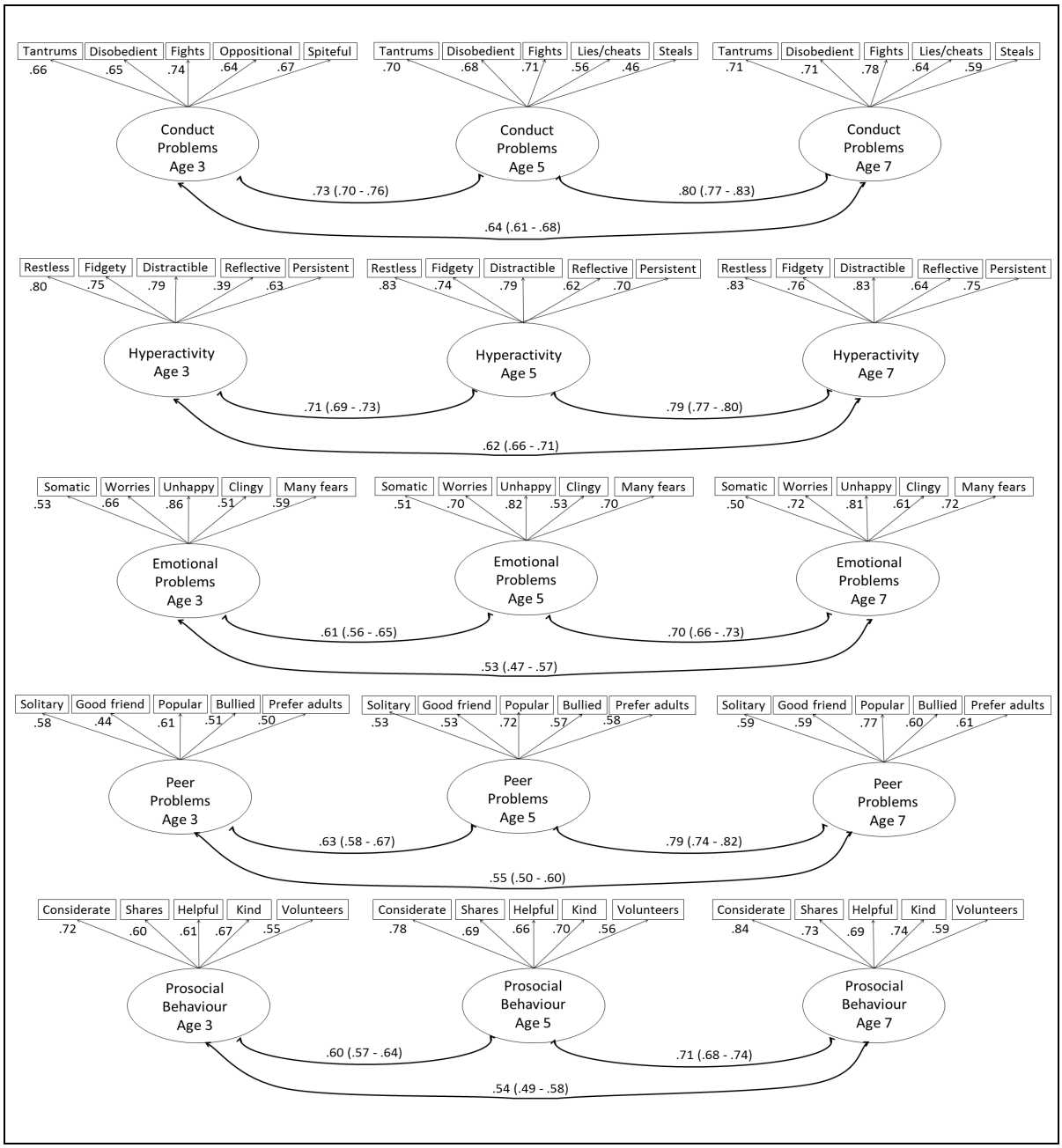
Alternative configurations of the SDQ data across all time points were compared using CFA. The 5 factor model fitted the data better (χ^2 = 28,332.77, df = 2520, p<.0005, RMSEA = .025, CFI = .905) than the 3 factor model (χ^2 = 36,768.937, df = 2589, p<.0005, RMSEA = .028, CFI = .874), and the 1 factor model (χ^2 = 62,171.903, df = 2622, p<.0005, RMSEA = .037, CFI = .780). Therefore the 5 factor model was used in subsequent analyses (Figure 2.1).

Applying the 5 factor configuration (Figure 2.1), standardised factor loadings for the preschool SDQ ranged from $.46 < \beta < .74$ (conduct problems), $.39 < \beta < .80$ (hyperactivity), $.51 < \beta < .86$ (emotional problems), $.44 < \beta < .61$ (peer problems) and $.55 < \beta < .72$ (prosocial). Several items had factor loadings below 0.6 (Table 2.1) suggesting these items are poor behavioural measures. However, the associated behavioural construct explains over 20% of the variance in the items for all but the preschool 'reflective' and 'good friend' items.

Table 2.1: Items with factor loadings below 0.6. FL = Factor loading; % Var = percentage of variance in items explained by associated factor. n = 16,659.

		Age 3		Age 5		Age 7	
Subscale	Item	FL	% Var	FL	% Var	FL	% Var
Conduct	Lies/cheats			.56	31		
	Steals			.46	21	.59	35
Hyperactivity	Reflective	.39	15				
Emotional	Somatic	.53	28	.51	26	.50	25
	Clingy	.51	26	.53	28		
Peer	Solitary	.58	34	.53	28	.59	35
	Good friend	.44	18	.53	28	.59	35
Prosocial	Volunteers	.55	30	.56	31	.59	35

Figure 2.1: Configural invariance model of SDQ showing factor loadings and across time correlations (99.95% confidence intervals), all significant at p<.0005. n = 16,659.



2.3.2 Reliability

Reliability analyses yielded comparable alpha and omega estimates (Table 2.2). Internal reliability of the standard SDQ was acceptable at ages 5 (alpha: .71 < α < .85; omega: .72 < ω < .86), and 7 (.76 < α < .86; .77 < ω < .88). Using the preschool version at age 3, only the

peer problems subscale failed to achieve the .70 benchmark for satisfactory internal reliability (.63 < α < .80; .66 < ω < .83). Examination of 99.95% confidence intervals indicated that, whilst mostly adequate at age 3, internal reliability was significantly higher at ages 5 and 7.

Table 2.2: Internal reliability: Cronbach's alpha (α) and McDonald's omega (ω) coefficients with 99.95% confidence intervals.

		Age 3	Age 5	Age 7
Conduct problems	n	13,225	14,007	12,854
	Alpha (α)	.800 (.790, .810)	.772 (.753, .790)	.823 (.809, .836)
	Omega (ω)	.808 (.799, .818)	.777 (.760, .794)	.830 (.817, .843)
Hyperactivity	n	12,369	13,526	12,651
	α	.786 (.776, .797)	.845 (.838, .853)	.858 (.851, .865)
	ω	.826 (.818, .834)	.864 (.858, .870)	.880 (.875, .886)
Emotional problems	n	12,369	13,526	12,651
	α	.746 (.727, .765)	.777 (.763, .790)	.794 (.783, .806)
	ω	.754 (.734, .774)	.785 (.771, .798)	.806 (.793, .817)
Peer problems	n	11,685	12,611	11,817
	α	.628 (.605, .650)	.712 (.692, .732)	.758 (.742, .775)
	ω	.658 (.639, .678)	.722 (.703, .741)	.767 (.751, .783)
Prosocial	n	12,527	14,042	12,997
	α	.766 (.754. .778)	.808 (.798, .819)	.840 (.831, .850)
	ω	.770 (.759, .782)	.811 (.801, .821)	.843 (.834, .853)

2.3.3 Measurement invariance

To establish if factor loading and threshold values were significantly different at age 3 compared to ages 5 and 7, we examined measurement invariance across time. When testing the subscales independently, fit indices were not significantly reduced when factor loadings were constrained to be equal across time compared to the configural model (Model A, Table 2.3) thereby demonstrating metric invariance for all subscales. Moreover, conduct problems and prosocial subscales showed no substantial loss of fit when thresholds were additionally constrained across time, demonstrating metric and strong invariance.

To establish the best fitting model, three further models were tested. In Model B all factor loadings and conduct problems and prosocial thresholds were constrained. Model C replicated model B with the additional constraint of the hyperactivity threshold which showed an insubstantial loss of fit from the configural model (ΔCFI = .002) when tested for scalar invariance (constraining thresholds only). In Model D all factor loadings and thresholds were constrained to be equal across time. Models B and C had acceptable fit indices while Model D exhibited poorer model fit. Model C was therefore the preferred model with acceptable fit indices and improved parsimony. This best fitting model demonstrated metric (factor loading) invariance for all subscales and strong (factor loading and threshold) invariance for conduct problems, hyperactivity and prosocial subscales.

Table 2.3: CFA for measurement invariance testing. Change in adjusted chi-square estimates obtained using DIFFTEST. † indicates preferred model (C). n = 16,659.

	Constraints	Construct(s)	Adjusted Chi-Square	df	Δ Adjusted Chi-square	Δ df	CFI	RMSEA
Configural Model A	None	All	28332.77	2520	-	-	0.905	0.025
Construct Testing (individual constructs fixed; remaining constructs vary across time)	Metric: equivalent factor loadings fixed equal across time	CON	28295.90	2526	36.87	6	0.906	0.025
		HYP	28181.30	2528	151.47	8	0.905	0.025
		EMO	28254.82	2530	77.95	10	0.908	0.024
		PEER	28236.45	2530	96.32	10	0.909	0.024
		PRO	28195.26	2530	137.51	10	0.907	0.025
	Scalar: equivalent factor thresholds fixed equal across time	CON	28408.71	2530	149.06	10	0.905	0.025
		HYP	28796.06	2534	933.41	14	0.903	0.025
		EMO	29654.46	2538	2226.11	18	0.9	0.025
		PEER	29977.20	2538	2549.87	18	0.899	0.025
		PRO	28476.11	2538	297.15	18	0.904	0.025

	Strong: equivalent factor loadings and thresholds fixed equal across time	CON	28223.94	2536	108.83	16	0.906	0.025
		HYP	27781.31	2542	551.46	22	0.903	0.025
		EMO	27597.93	2548	734.84	28	0.903	0.025
		PEER	27505.96	2548	826.81	28	0.903	0.025
		PRO	27993.82	2548	338.95	28	0.906	0.025
Model B	All equivalent factor loadings; equivalent CON and PRO thresholds fixed equal across time	All	26356.10	2592	699.18	72	0.912	0.023
Model C	**All equivalent factor loadings; equivalent CON, PRO & HYP thresholds fixed equal across time**	**All**	**26771.34**	**2606**	**940.66**	**86**	**0.911**	**0.024**
Model D	All equivalent factor loadings; all equivalent thresholds fixed equal across time	All	64782.95	2662	22876.52	142	0.771	0.037

2.3.4 Construct validity

We assessed convergent and discriminant validity (Table 2.4) utilizing the preferred Model C from measurement invariance testing. The only subscale to exceed the .50 cut-off for satisfactory internal convergent validity was hyperactivity (AVE = .60). AVE scores for the remaining subscales ranged from .34 (peer problems) to .49 (conduct problems). Squared inter-factor correlations ranged from .02 < r^2 < .42. All subscales demonstrated adequate external discriminant validity with AVE scores lower than squared inter-factor correlations. Further, correlations between factors at age 3 ranged from .15 < β < .68 fulfilling Kline's (2005) 'r < .85' cut-off for distinct factors.

Table 2.4: r^2 values and average variance explained (AVE) scores for Configural Model A. n = 16,659.

		R^2 values - Configural (Model A)			Preferred (Model C)
Factor	Item	3	5	7	**AVE**
Conduct	Tantrums	0.44	0.49	0.50	0.47
	Disobedient	0.43	0.47	0.51	0.46
	Fights	0.54	0.50	0.61	0.54
		0.47	**0.49**	**0.54**	**0.49**
Hyperactivity	Restless	0.64	0.69	0.70	0.68
	Fidgety	0.56	0.55	0.58	0.56
	Distractible	0.62	0.62	0.68	0.64
	Persistent	0.40	0.50	0.56	0.50
		0.56	**0.59**	**0.63**	**0.60**
Emotional	Somatic	0.28	0.26	0.25	0.26
	Worries	0.43	0.48	0.52	0.49
	Unhappy	0.74	0.68	0.67	0.69

	Clingy	0.26	0.28	0.37	0.31
	Many fears	0.35	0.49	0.52	0.46
		0.41	**0.44**	**0.46**	**0.44**
Peer	Solitary	0.33	0.28	0.35	0.31
	Good friend	0.19	0.29	0.35	0.27
	Popular	0.37	0.52	0.60	0.50
	Bullied	0.27	0.33	0.36	0.32
	Prefer adults	0.25	0.33	0.37	0.32
		0.28	**0.35**	**0.41**	**0.34**
Prosocial	Considerate	0.51	0.60	0.70	0.60
	Shares	0.36	0.48	0.53	0.46
	Helpful	0.37	0.43	0.48	0.42
	Kind	0.45	0.50	0.54	0.49
	Volunteers	0.30	0.31	0.34	0.31
		0.40	**0.46**	**0.52**	**0.46**

Three adapted items distinguish the preschool and school-age SDQs (see methods for details). Comparing items across age, both preschool conduct problem items and the school-aged hyperactivity item had higher r^2 values; CFAs confirmed that both preschool conduct problem items and the school-aged hyperactivity item were significantly better indicators of the factors than their alternative counterparts (Table 2.5).

Table 2.5: r^2 values for adapted preschool SDQ items (and equivalent age 5 and 7 items); and CFA comparison with configural model A. n = 16,659.

		r^2 (age)			Model	Adjusted Chi-square	df	Δ Adjusted Chi-square	Δ df	CFI	RMSEA
Factor	Items (age)	*3*	5	7	Configural Model A	28332.77	2520	-	-	0.905	0.025
CON	Argumentative (age 3) Lies/cheats (age 5 & 7)	0.41	0.32	0.41	CON factor loadings fixed equal across time	28087.59	2524	91.957	4	0.906	0.025
	Spiteful (age 3) Steals (age 5 & 7)	0.45	0.21	0.35							
HYP	Can be reflective (age 3) Is reflective (age 5 & 7)	0.15	0.38	0.41	HYP factor loadings fixed equal across time	28868.687	2522	197.896	2	0.903	0.025

External convergent validity of each SDQ factor was supported by strong correlations between scores at ages 3, 5 and 7 (Figure 2.1). Chi-square difference testing revealed no significant differences at the $p < .0005$ level between factor correlations measured at age 3 and 5 and those measured at age 5 and 7. Strong correlations between age 3 and age 7 scores provide further evidence of external convergent validity (Table 2.6).

Table 2.6: Standardized across-time factor correlations; age 3 to 5 (below diagonal), age 5 to 7 (above diagonal). All estimates significant at $p < .0005$. † See Figure 1. n = 16,659.

	Conduct	Hyperactivity	Emotional	Peer	Prosocial
Conduct	†	.63	.41	.48	- .49
Hyperactivity	.58	†	.31	.45	- .40
Emotional	.40	.28	†	.54	- .20
Peer	.42	.37	.50	†	- .40
Prosocial	- .40	- .30	- .12	- .27	†

2.3.5 Predictive criterion validity

Probit and linear regression were used to assess predictive criterion validity using external criteria of age 5 diagnoses of ADHD, ASD/AS and PSE development (Table 7). Only preschool conduct problems and hyperactivity subscales independently predicted age 5 outcomes at the $p < .0005$ significance level. Hyperactivity positively predicted ADHD ($\beta = .41$) and ASD/AS ($\beta = .58$), and negatively predicted PSE development ($\beta = -.16$), while conduct problems positively predicted ADHD ($\beta = .40$) and negatively predicted ASD/AS ($\beta = -.55$). In a simple model without covariates, conduct problems predicted ASD/AS positively, but the relationship became negative when covariates were added.

Table 2.7: Standardized probit (ADHD, ASD/AS) and linear (PSE) regression estimates and standard errors for age 5 outcomes. ADHD: Attention Deficit Hyperactivity Disorder, ASD/AS: Autism Spectrum Disorder/Asperger Syndrome, PSE: Personal, Social and Emotional Development. n = 16,508 * p < .0005.

	ADHD		ASD/AS		PSE	
Factor	β	S.E.	β	S.E.	β	S.E.
Conduct problems	.40*	.12	-.55*	.16	-.08	.07
Hyperactivity	.41*	.09	.58*	.09	-.16*	.04
Emotional problems	-.31	.13	-.13	.15	.03	.09
Peer problems	.25	.13	.40	.16	-.15	.10
Prosocial	.16	.11	-.40	.12	-.03	.08

2.4 Discussion

This is the first longitudinal examination of the psychometric properties of the parent-reported preschool SDQ from preschool to school-age developmental stages. The 5 factor model established for the school-age SDQ provided an adequate fit to preschool SDQ data. Subscales exhibited good internal reliability and adequate discriminant validity, albeit alongside weaker internal convergent validity. All subscales demonstrated metric invariance over time, with conduct problems, hyperactivity and prosocial subscales presenting strong invariance over time. Conduct problems and hyperactivity subscales also predicted clinical disorders 2 years later.

Our findings diverge from previous research in two areas. First, we reported poor model fit for the alternative 3 factor configuration. Previous studies reported adequate model fit for both 5 and 3 factor solutions using school-age (Goodman et al., 2010) and preschool populations (Ezpeleta et al., 2013). The 3 factor model has been recommended for use with low-risk community samples and epidemiological studies, and the 5 factor model for use with high-risk and clinical samples, based on all reported psychometric properties (Ezpeleta et al., 2013; Goodman et al., 2010; Hill & Hughes, 2008). In this study, the 5 factor model fitted the MCS data better, supporting utilization of each of the 5 subscales to assess child behaviours across the preschool to school-age developmental stages.

Second, we reported higher Cronbach's alpha reliability scores compared with most preschool and school-age validation studies (Stone et al., 2010; Theunissen et al., 2013) with only the preschool peer problems subscale failing to meet the $\alpha > .70$ criteria for satisfactory internal reliability. Stone et al (2010) reported weighted mean internal consistency scores for 26 school-age SDQ studies which, consistent with preschool validation studies, exhibited poor to satisfactory internal consistency (Stone et al., 2010; Theunissen et al., 2013). Due to skewness and the ordered categorical nature of our variables, we estimated alpha within a SEM framework which resulted in higher alpha coefficients (Maydeu-Olivares et al., 2010). Our omega reliability analyses yielded results consistent with previous studies reporting omega reliabilities for preschool and school-age SDQs (Ezpeleta et al., 2013; Stone et al., 2010).

The longitudinal design of the MCS provided SDQ scores from the preschool and school-age developmental stages which enabled the first assessment of whether the SDQ's measurement model was consistent across this developmental period. We reported metric invariance for all

subscales and strong invariance for conduct problems, hyperactivity and prosocial subscales. As it was inappropriate to constrain the three unique preschool items across age, thus invariance only applies to the 22 consistently asked items.

This was the first examination of discriminant validity using the preschool SDQ. Satisfactory discriminant validity was observed for all preschool subscales. Although discriminant validity of the preschool SDQ has not previously been addressed, poor discriminant validity was reported using school-age samples (Goodman et al., 2010; Hill & Hughes, 2008). In both instances multitrait-multimethod approaches were used to establish poorer discrimination between externalizing and prosocial factors compared to internalizing factors. Weak internal convergent validity suggested some items are not strongly related to their associated factors. Only the hyperactivity items demonstrated satisfactory internal convergent validity using AVE scores: items exhibited adequate communality, thus the majority of item variance was explained by the hyperactivity factor. For the remaining subscales less than half the item variance was explained by associated factors, suggesting items may not be clear and distinct indicators of the behavioural constructs they are designed to reflect. Item variance explained by respective factors increased with age, consistent with previous research that observed parent-reported SDQ factors typically accounted for 50% of item variance for 10 to 12 year olds and < 50% for 5 to 7 year olds (Niclasen et al., 2013). The two preschool specific conduct problem items had adequate communalities compared to age 5 equivalents; conversely, the preschool 'reflective' item was a poor indicator with the hyperactivity subscale explaining only 15% of item variance.

The predictive utility of the preschool SDQ was supported with evidence of external convergent and predictive criterion validity. Substantial positive correlations between

corresponding factors measured at ages 3, 5 and 7 years support the predictive validity of SDQ subscales across 2 and 4 year periods. Moreover, correlations between preschool and age 5 scores were comparable to those between age 5 and 7 scores, supporting predictive validity of the preschool SDQ as similar to the school-age SDQ administered at age 5.

Preschool conduct problems and hyperactivity subscales demonstrated predictive criterion validity over 2 years. Hyperactivity positively predicted ADHD, ASD/AS and PSE. Conduct problems positively predicted ADHD. Our findings are consistent with research using school-age populations in which parent-reported SDQ scores predicted a range of developmental outcomes 3 years later including ADHD and ASD (A. Goodman et al., 2010). A weak positive simple relationship between conduct problems and ASD/AS became negative when other SDQ subscales were included as covariates. This suggests that children with conduct problems at age 3 were less likely to be diagnosed with ASD/AS 2 years later taking covariates into account. This is consistent with research using a UK school-age population (A. Goodman et al., 2010; Russell et al., 2013). This negative relationship may reflect overlap with other SDQ subscales, particularly hyperactivity, a robust independent predictor of later ASD/AS.

2.4.1 Limitations

We found substantial continuities in peer and emotional problems, as measured by the SDQ, from preschool to school-age children, however these subscales did not independently predict external measures of psychopathology. Rather than suggesting these scales lack clinical value, this is likely to reflect the range of outcomes available in the MCS data set. Specifically, it is plausible that these subscales would independently predict future internalising problems such as depressed mood and anxiety. Multiple-informants of child

behaviours would enhance validity of findings, with teacher-report likely to be most valuable at this age, although difficult to collect in UK samples as preschool education is not compulsory. The SDQ impact supplement which investigates chronicity, distress, social impairment and burden was excluded from analyses; while this provides clinically useful information, the brevity and accessibility of the 25-item questionnaire increases suitability for widespread use (Goodman & Scott, 1999). Future research focussed on application in clinical settings might usefully address the impact supplement and could usefully evaluate clinical cut-points for psychiatric caseness.

2.4.2 Conclusion

The school-age SDQ has been extensively validated for its intended use as a screening tool to detect 4 to 16 year olds at risk of clinical or developmental disorders (Goodman & Scott, 1999; Goodman, 1997; Stone et al., 2010). The current study confirms satisfactory psychometric properties and predictive criterion validity for the adapted preschool version as comparable to the school-age SDQ. This study therefore affirms its clinical utility as a brief measure to identify 3 to 4 year olds with emotional and behavioural difficulties. Furthermore, this study confirms the use of the preschool SDQ in conjunction with its school-age counterpart as an appropriate tool to measure a range of behavioural dimensions across childhood.

In the following Chapters of this thesis, the preschool SDQ will be used alongside the school-age SDQ to measure child behaviours across an 8 year period of childhood. The confirmed 5 factor structure affirms utility of each subscale to measure intended behaviours, thus enabling evaluation of specific dimensions of child externalizing (conduct problems and hyperactivity)

and internalizing (emotional and peer problems) behaviours in relation to maternal psychopathology.

Chapter 3: Stability and reciprocity of maternal depression and childhood emotional and behavioural problems

3.1 Introduction

Maternal depressed mood (MDM) and behavioural problems in children frequently occur together (Dix & Meunier, 2009; Lovejoy et al., 2000). As reviewed in Chapter 1, a substantial body of literature has examined longitudinal associations between maternal and child psychopathology. Influences of MDM on child behaviour problems ('parent effects') and the effects of child behaviours on MDM ('child effects') have been commonly reported. Reciprocal effects have been demonstrated where MDM predicts child behaviour at the next assessment, and child behaviour predicts MDM at subsequent assessments, thus both are active agents influencing one another over time (Burke et al., 2008; Patterson, 1982; Shaw, Gross, et al., 2009). Reciprocity between MDM and the externalizing behaviours of children have been reported (Bagner et al., 2013; Choe et al., 2014, 2013; Gross et al., 2009; Harvey & Metcalfe, 2012; Wiggins et al., 2014), however considerably less is understood about the reciprocal relationship between MDM and child internalizing behaviours (Elgar et al., 2003; Jaffee & Poulton, 2006; Nicholson et al., 2011). Moreover, results to date have been inconclusive, particularly with regards to the moderating effects of age and gender, and the magnitude of effects for mothers versus children.

This chapter will explore stability and bidirectionality of MDM and child conduct problems, hyperactivity, emotional problems and peer problems from age 3 to age 11 using

autoregressive cross-lagged (ACL) structural equation models. ACL models provide a useful framework to assess the individual contribution of each member of a dyad to transactional relationships. There are two central components to an ACL model; both provide different empirical insights into the transactional relationship. First, autoregressive paths quantify how much variance in behaviours on one occasion is explained by scores of the same measure at a prior occasion, thus they provide a measure of the continuity of constructs over time. Second, cross-lagged paths represent bidirectional effects which quantify how much variance in the behaviour of one member of the dyad can be explained by scores of the other member of the dyad on the previous occasion independently from autoregressive continuity.

This chapter disentangles the relationship between MDM and child internalizing and externalizing behaviours using ACL models. Reciprocity between MDM and child behaviours was examined to determine if effects vary according to agent (parent/child), developmental stage and gender. Significant positive bidirectional effects were anticipated, however due to inconclusive results from previous studies, examination of age and gender effects was exploratory. No hypotheses were formulated regarding the magnitude of MDM effects on child behaviour (parent effects) relative to the magnitude of child behaviour effects on MDM (child effects).

3.2 Method

3.2.1 Sample

As in Chapter 2, data from the Millennium Cohort Study was analysed. The current sample differed from that used in the previous study in two ways. First, family data was used where MDM scores obtained from biological mothers were provided on at least one occasion, in

addition to child behaviours measured on at least one occasion. Second, an additional wave of data was included, measured when children were 11 years old. The same exclusion criteria employed in the previous study were used, thus children who were more than one year outside of the intended age were excluded from analysis. Table 3.1 provides details of the data used at each assessment. The final analysis sample consisted of 16,941 distinct children (49% female).

Table 3.1: Number and response rate of respondent families, mean age and age range

	Age			
	3	5	7	11
Entire MCS sample:				
Responding MCS families	15,590	15,246	13,857	13,287
Response rate	81%	79%	72%	69%
Age range	2.65 - 4.57	4.40 - 6.13	6.34 - 8.15	10.17 - 12.33
Mean age	3.15	5.22	7.24	11.17
Current study:				
Number of participants	15,269	13,568	12,004	10,646
Age range	2.65 – 4.00	4.40 - 6.00	6.34 - 8.00	10.17 - 11.92
Mean age	3.13	5.22	7.23	11.16

3.2.2 Measures

Maternal depressed mood

MDM over the past month was self-reported by mothers when children were 3, 5, 7, and 11 using the Kessler 6 (Kessler et al., 2002). Items assess the frequency of depressed feelings

e.g. *'about how often did you feel hopeless?'* and were scored from 0 (none of the time) to 4 (all of the time). The Kessler 6 discriminates between community and clinical cases of mood disorders (Kessler et al., 2002). Internal consistency reliability ranged from Cronbach's α=.91 to α=.93.

Emotional and behavioural difficulties

Child emotional and behaviour problems were assessed using the Strengths and Difficulties Questionnaires as described in Chapter 2. One notable difference is that the current study used an additional assessment at age 11.

3.2.3 Analysis

Building on the results of Chapter 2, we first assessed the factor structure stability of the MDM and 4 SDQ subscales over time (i.e. measurement invariance) using Confirmatory Factor Analysis (CFA), with items treated as ordinal. The 4 SDQ difficulty subscales (conduct, hyperactivity, emotional and peer problems) and MDM scale were tested for measurement invariance across time. Extending the previous study that assessed measurement invariance using the three time-points, the current study used all four time-points. In the best fitting measurement model from the previous study, SDQ subscales were first considered separately and then modelled together; however in in the current study, subscales were only considered separately. Using the same methods described in Chapter 2, measurement invariance was tested across time. Parameters were standardized by fixing factor means to zero and variances to one.

Next, we tested the hypothesised relationships of continuity and reciprocity between measurements of maternal depression and child behavioural problems. For each SDQ

subscale we utilized the best fitting measurement model alongside the best fitting MDM measurement model, and added autoregressive and cross-lagged paths between the respective SDQ factor and the MDM factor, creating four sets of autoregressive cross-lagged structural equation models (ACL model combinations A-D; Figure 3.1). Autoregressive paths estimated the direct influence of previous behaviour on later behaviour, while cross-lagged parameters tested reciprocal effects between parent and child behaviours. For each SDQ subscale-MDM combination, we started with a model in which all causal paths were free (Model 1); autoregressive paths spanning the equal age gaps of 3 to 5 and 5 to 7 were then constrained equal (Models 2a-2c) as relationships across equal periods of time might be expected to be equal. Next, cross-lagged paths between SDQ and MDM factors between ages 3 to 5 and 5 to 7 were fixed equal (Models 3a-3c) to test for temporal invariance in these relationships. Finally, equivalent paths from child behaviour to MDM were fixed equal to paths from MDM to child behaviour (i.e. parent/child effects; Model 4) were fixed equal to examine differences in the magnitude between parent and child effects. Paths from age 7 to age 11 scores on each factor were not constrained to match age 3 to age 5 or age 5 to age 7 paths because of the greater time gap between assessments.

Finally gender differences in estimates within each ACL model combination were examined by extending Model 4 to a multigroup ACL that allowed all parameters (item-factor loadings, thresholds, item residual variances, factor means, factor variances, intra-factor correlations and causal paths) to differ between boys and girls (Model 5a). First invariance was examined in the measurement model; loadings and then thresholds were successively fixed equal across genders (Models 5b-5c). Then the same testing strategy was applied to the structural part of ACL models to assess the equality of relationships across genders. Specifically incremental constraints across gender were successively applied to autoregressive paths (Model 6a-c),

cross-lagged paths (Model 7) and finally within-time correlations (Models 8a, 8b). Compromise in model fit at any stage indicated gender differences in the respective parameters.

As in the previous study, Mplus 7.11 (Muthén and Muthén, 1998-2014) was used and the same technical specifications described in Chapter 2 were applied. In addition, the same criteria was applied to assessing models based on the comparative fit index (CFI) and the root mean square error of approximation (RMSEA) goodness-of-fit indices, the full details of which are described in Chapter 2.

3.3 Results

3.3.1 Measurement invariance across time

Invariance testing of the measurement model of the MDM and SDQ subscales across time is summarised in Table 3.2. All scales demonstrated the critical property of metric invariance, i.e. reduction in model fit was trivial when item-factor loadings were fixed equal across time. Although fixing all item-factor thresholds equal across time (i.e. strong invariance) reduced CFI fit indices, partial strong invariance was demonstrated by fixing the least invariant thresholds to equality across time, with non-significant loss of model fit according to the CFI index (for details see Chapter 2).

ACL model pathway invariance across time

When testing the invariance of the hypothesised causal paths (i.e. the structural part of the ACL models) across time (Tables 3.3-3.6, Models 1-4), estimates of both autoregressive and cross-lagged paths from age 3 to age 5 were not significantly different in size or sign from

equally spaced age 5 to age 7 estimates. Additionally, at each time-point paths from MDM to child behaviour (parent-to-child cross-lagged estimates) were not significantly different to equivalent paths from child behaviours to MDM (child-to-parent cross-lagged estimates).

Table 3.2: Results from measurement invariance testing across time.

Construct	Model	Constraints	χ^2	df	CFI	RMSEA
Maternal depressed mood	Configural	None	1969.81	222	.992	.022
	Metric	All factor loadings	87.17	12	.993	.020
	Strong	**All factor loadings & 2 thresholds**	**225.74**	**33**	**.993**	**.019**
Conduct problems	Configural	None	1065.81	134	.982	.020
	Metric	All factor loadings	57.32	10	.985	.018
	Strong	All factor loadings & all thresholds	239.95	25	.980	.019
	Partial strong	**All factor loadings & 3 thresholds**	**108.02**	**21**	**.984**	**.017**
Hyperactivity	Configural	None	6700.70	144	.950	.052
	Metric	All factor loadings	174.57	11	.958	.046
	Strong	All factor loadings & all thresholds	1162.62	34	.949	.047
	Partial	**All factor loadings & 4**	**748.41**	**28**	**.953**	**.046**

	strong	**thresholds**				
Emotional problems	Configural	None	1036.10	144	.981	.019
	Metric	All factor loadings	75.13	12	.982	.018
	Strong	All factor loadings & all thresholds	3342.64	39	.890	.041
	Partial strong	**All factor loadings & 1 threshold**	**84.37**	**15**	**.982**	**.018**
Peer problems	Configural	None	1840.01	144	.956	.026
	Metric	All factor loadings	144.66	12	.957	.025
	Strong	All factor loadings & all thresholds	2303.80	39	.887	.037
	Partial strong	**All factor loadings & 1 threshold**	**162.80**	**15**	**.956**	**.025**

ACL Model invariance across gender

Using multigroup CFA to assess gender differences in measurement invariance (Models 5a-5c), strong invariance across gender was observed indicating that child gender did not influence scale operationalization. In increasingly constrained models, autoregressive (Models 6a-6b) and then cross-lagged (Models 6c) parameters were constrained to be equal across gender. Non-significant reduction in model fit indicated that the autoregressive and cross-lagged parameters were invariant across gender indicating no gender differences in these parameters. Constraining parent and child effects to be equal to one another and equal across gender (Model 8) provided no substantial loss of fit. Finally, gender differences were not observed in within-time correlations between mother and child behaviours (Models 8a-

8b). Constraining cross-lagged estimates to equality across agent and gender did not reduce model fit, thus parent and child effects were not only equal to one another over time, but did not significantly differ by child's gender. These results were consistent across the four models for each of the SDQ subscales.

3.3.2 Autoregressive cross-lagged model

Our hypothesized ACL models, with time and gender invariant parameter and path constraints (Model 8b), provided a satisfactory fit to observed data for each of the four SDQ subscale and MDM combinations (Tables 3.3-3.6, Figures 3.1-3.4). Path estimates from Model 8b are given in Figure 3.1-3.4. Significant positive autocorrelations demonstrated behavioural continuity in all constructs. Autoregressive estimates for conduct problems, hyperactivity and MDM were higher from age 3 to age 7 than from age 7 to age 11 as indicated by non-overlap of 99% confidence intervals surrounding autoregressive estimates. Bidirectional effects were demonstrated with significant positive cross-lagged parameters, thus MDM significantly predicted child behaviours at the next assessment (parent effects) and likewise child behaviours predicted MDM at the next assessment (child effects).

Focussing on Model 8b, reciprocal child and parent effects were stronger between MDM and child internalizing (C and D) compared to externalizing behaviours (A and B). Confidence intervals surrounding bidirectional estimates for MDM and hyperactivity did not overlap with those surrounding reciprocal associations between MDM and internalizing problems, suggesting that the magnitude of bidirectional effects are stronger for internalizing problems than hyperactivity. Some overlap was observed in confidence intervals for MDM with conduct problems and MDM with internalizing behaviours.

Table 3.3: Autoregressive cross-lagged model for maternal depressed mood (MDM) and conduct problems (CON), r = within-time correlation, n = 16,941 (unconditional), n = 16,301 (f: 7966; m: 8335) multigroup.

Model	No.	Equality constraints	X^2	df	Test	ΔX^2	Δdf	CFI	RMSEA
CFA		8 factor CFA	3143.96	808				.991	.013
Unconditional (testing for differences across time)	1	Partial strong invariance across time	16565.87	901	1-v-CFA	7430.40	93	.940	.032
	2a	DEP->DEP (age 3-5, 5-7)	17515.72	902	2a-v-1	363.02	1	.936	.033
	2b	CON->CON (age 3-5, 5-7)	16526.95	902	2b-v-1	14.66	1	.940	.032
	2c	DEP & CON (age 3-5, 5-7)	17517.03	903	2c-v-2a	34.41	1	.936	.033
			17517.03	903	2c-v-2b	381.07	1	.936	.033
	3a	DEP & CON; Child effects (CON -> DEP)	17469.63	904	3a-v-2c	35.53	1	.936	.033
	3b	DEP & CON; Parent effects (DEP -> CON)	17422.44	904	3b-v-2c	13.79	1	.937	.033
	3c	DEP & CON; Child & parent effects	17325.64	905	3c-v-3a	6.87	1	.937	.033
			17325.64	905	3c-v-3b	27.42	1	.937	.033
	4	DEP & CON; Child effects = parent effects	17321.65	907	4-v-3c	86.71	2	.937	.033
Multigroup	5a	Model 4 & configural invariance (gender)	16849.31	1815				.940	.032

(testing for differences across gender)	5b	Model 4 & metric invariance (gender)	16017.55	1828	5b-v-5a	41.59	13	.943	.031
	5c	Model 4 & strong invariance (gender)	15930.51	1923	5c-v-5b	452.37	95	.944	.030
	6a	DEP->DEP (age 3-5, 5-7)	15679.23	1925	6a-v-5c	1.49	2	.945	.030
	6b	CON->CON (age 3-5, 5-7)	15752.41	1925	6b-v-5c	1.66	2	.945	.030
	6c	DEP & CON (age 3-5, 5-7)	15399.63	1927	6c-v-6a	4836.48	2	.946	.029
			15399.63	1927	6c-v-6b	1.33	2	.946	.029
	7	DEP & CON; Child effects = parent effects	14917.72	1929	7-v-6c	7.09	2	.948	.029
	8a	DEP & CON; Child effects = parent effects; r (age 3)	14252.12	1930	8a-v-7	0.01	1	.951	.028
	8b	DEP & CON; Child effects & parent effects; r (all)	12585.67	1933	8b-v-8a	5.42	1	.957	.026

Figure 3.1: Standardized autoregressive cross-lagged model of maternal depressed mood (MDM) and conduct problems (CON).

n = 16,301 (f: 7966; m: 8335). * p < .0001.

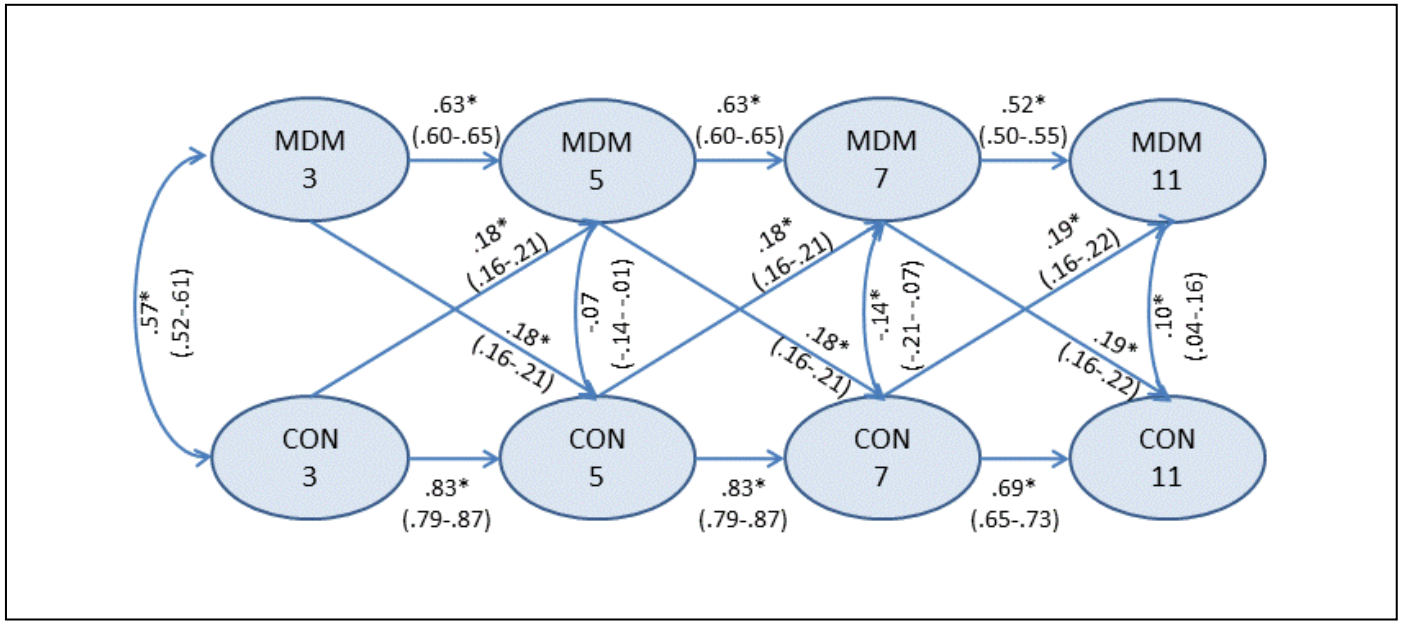


Table 3.4: Autoregressive cross-lagged model for maternal depressed mood (MDM) and hyperactivity (HYP) , r = within-time correlation, n = 16,941 (unconditional), n = 16,301 (f: 7966; m: 8335) multigroup.

Model	No.	Equality constraints	X^2	df	Test	ΔX^2	Δdf	CFI	RMSEA
CFA		8 factor CFA	8389.33	808				.975	.024
Unconditional	1	Partial strong invariance across time	26262.81	906	1-v-CFA	10333.49	98	.918	.041
	2a	DEP->DEP (age 3-5, 5-7)	27232.76	907	2a-v-1	362.11	1	.915	.041
	2b	HYP->HYP (age 3-5, 5-7)	26392.06	907	2b-v-1	124.94	1	.917	.041
	2c	DEP & HYP (age 3-5, 5-7)	27472.33	908	2c-v-2a	398.55	1	.914	.042
			27472.33	908	2c-v-2b	173.81	1	.914	.042
	3a	DEP & HYP; Child effects (HYP -> DEP)	27318.75	909	3a-v-2c	37.33	1	.914	.042
	3b	DEP & HYP; Parent effects (DEP -> HYP)	27416.98	909	3b-v-2c	62.10	1	.914	.042
	3c	DEP & HYP; Child & parent effects	27110.09	910	3c-v-3a	42.97	1	.915	.041
			27110.09	910	3c-v-3b	22.23	1	.915	.041
	4	DEP & HYP; Child effects = parent effects	26014.90	912	4-v-3c	3.89	2	.919	.040
Multigroup	5a	Model 4 & configural invariance (gender)	24200.63	1824				.924	.039

	5b	Model 4 & metric invariance (gender)	23395.61	1834	5b-v-5a	36.70	10	.926	.038
	5c	Model 4 & strong invariance (gender)	24314.07	1930	5c-v-5b	1491.12	96	.924	.038
	6a	DEP->DEP (age 3-5, 5-7)	23492.51	1932	6a-v-5c	1.80	2	.926	.037
	6b	HYP->HYP (age 3-5, 5-7)	23970.46	1932	6b-v-5c	4.70	2	.925	.037
	6c	DEP & HYP (age 3-5, 5-7)	23005.79	1934	6c-v-6a	7.38	2	.928	.037
			23005.79	1934	6c-v-6b	3.94	2	.928	.037
	7	DEP & HYP; Child effects = parent effects	21988.09	1936	7-v-6c	1.45	2	.933	.036
	8a	DEP & HYP; Child effects = parent effects; r (age 3)	20799.09	1937	8a-v-7	1.85	1	.936	.035
	8b	DEP & HYP; Child effects & parent effects; r (all)	17281.64	1940	8b-v-8a	3.84	3	.948	.031

Figure 3.2: Standardized autoregressive cross-lagged model of maternal depressed mood (MDM) and hyperactivity (HYP). n = 16,301 (f: 7966; m: 8335). * p < .0001.

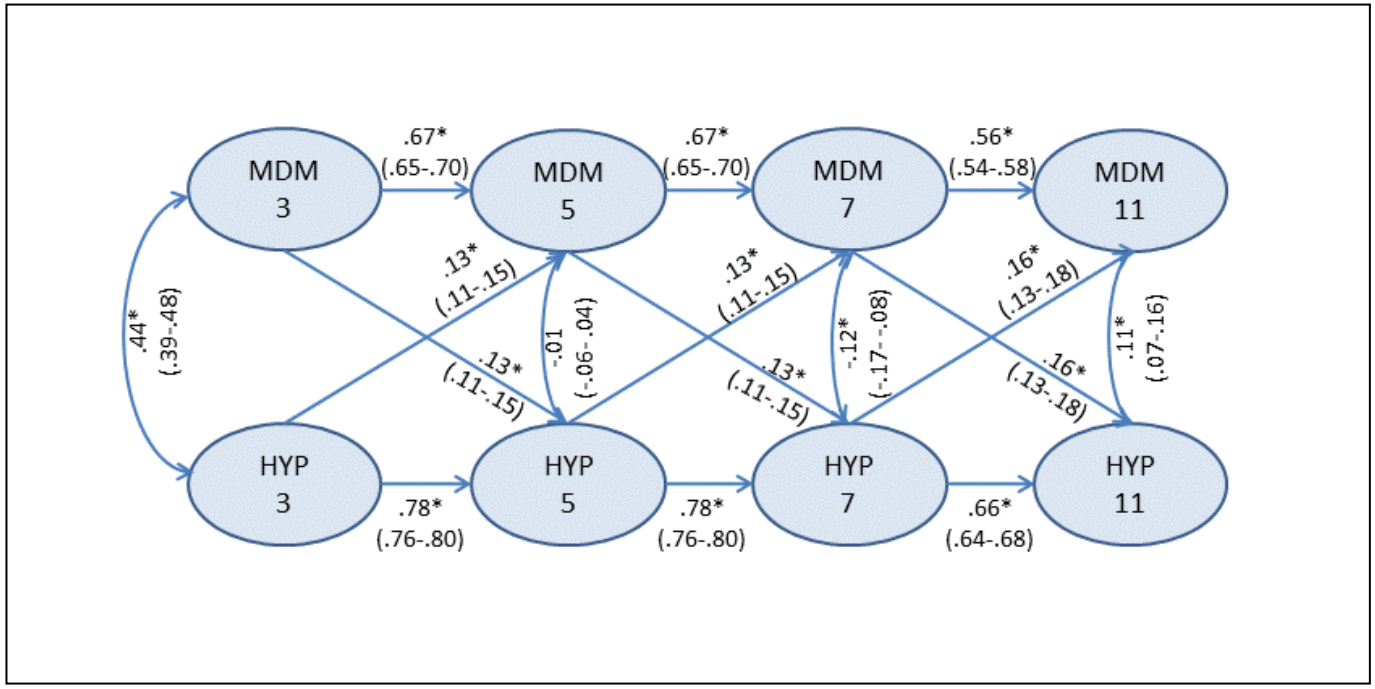


Table 3.5: Autoregressive cross-lagged model for maternal depressed mood (MDM) and emotional problems (EMO), r = within-time correlation, n = 16,941 (unconditional), n = 16,301 (f: 7966; m: 8335) multigroup.

Model	No.	Equality constraints	X^2	df	Test	ΔX^2	Δdf	CFI	RMSEA
CFA		8 factor CFA	3928.51	808				.988	.015
Unconditional	1	Partial strong invariance across time	17816.33	899	1-v-CFA	7115.65	91	.936	.033
	2a	DEP->DEP (age 3-5, 5-7)	18119.60	900	2a-v-1	136.68	1	.935	.034
	2b	EMO (age 3-5, 5-7)	17692.63	900	2b-v-1	3.56	1	.937	.033
	2c	DEP & EMO (age 3-5, 5-7)	18063.59	901	2c-v-2a	17.67	1	.935	.034
			18063.59	901	2c-v-2b	149.17	1	.935	.034
	3a	DEP & EMO; Child effects (CON -> DEP)	18042.27	902	3a-v-2c	58.85	1	.935	.034
	3b	DEP & EMO; Parent effects (DEP -> CON)	17905.41	902	3b-v-2c	22.32	1	.936	.033
	3c	DEP & EMO; Child & parent effects	17854.69	903	3c-v-3a	7.98	1	.936	.033
			17854.69	903	3c-v-3b	46.71	1	.936	.033
	4	DEP & EMO; Child effects = parent effects	17524.50	905	4-v-3c	41.61	2	.937	.033

Multigroup	5a	Model 4 & configural invariance (gender)	16454.68	1810				.940	.032
	5b	Model 4 & metric invariance (gender)	15848.31	1819	5b-v-5a	14.075	9	.943	.031
	5c	Model 4 & strong invariance (gender)	15425.66	1925	5c-v-5b	216.62	106	.945	.029
	6a	DEP->DEP (age 3-5, 5-7)	15245.71	1927	6a-v-5c	0.979	2	.946	.029
	6b	EMO->EMO (age 3-5, 5-7)	15328.62	1927	6b-v-5c	9.907	2	.945	.029
	6c	DEP & EMO (age 3-5, 5-7)	14977.30	1929	6c-v-6a	7.578	2	.947	.029
			14977.30	1929	6c-v-6b	14.635	2	.947	.029
	7	DEP & EMO; Child effects = parent effects	14581.61	1931	7-v-6c	7.22	2	.949	.028
	8a	DEP & EMO; Child effects = parent effects; r (age 3)	13883.72	1932	8a-v-7	1.45	1	.951	.028
	8b	DEP & EMO; Child effects & parent effects; r (all)	11775.51	1935	8b-v-8a	8.82	3	.960	.025

Figure 3.3: Standardized autoregressive cross-lagged model of maternal depressed mood (MDM) and emotional problems (EMO). n = 16,301 (f: 7966; m: 8335). * p < .0001.

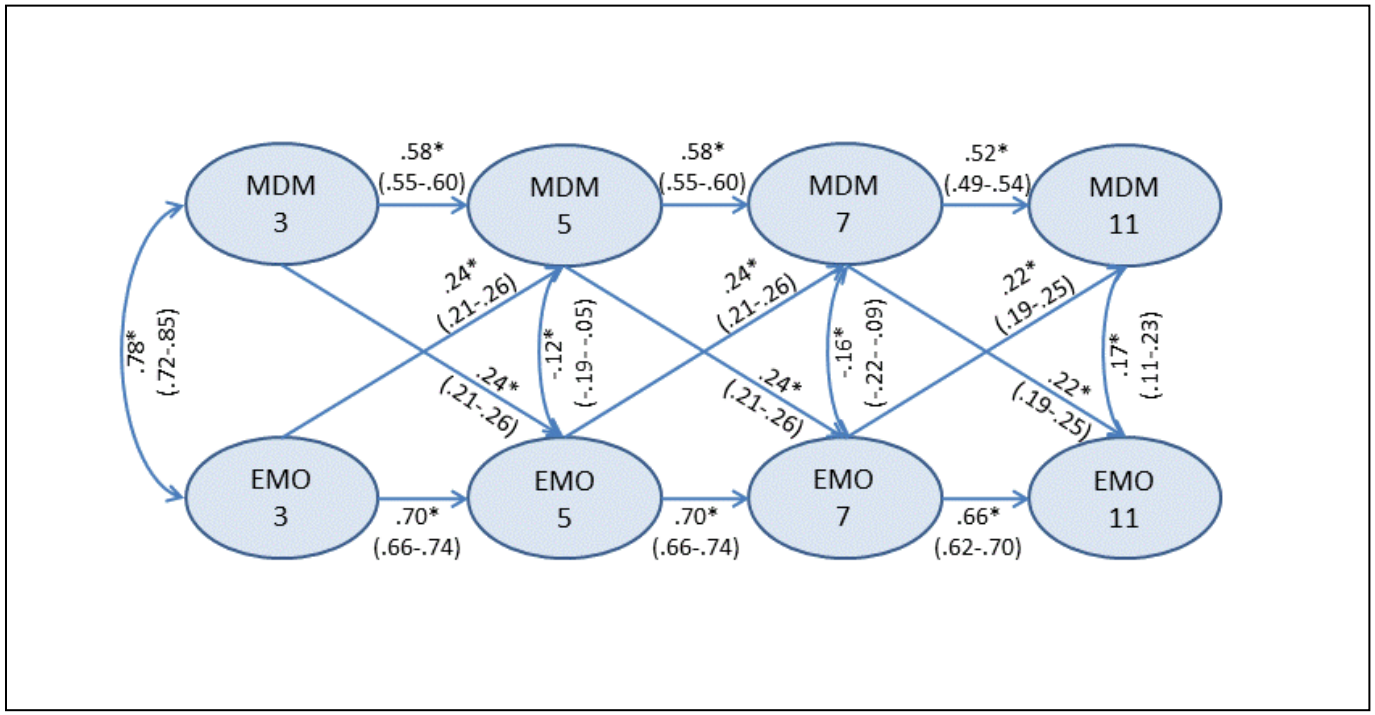
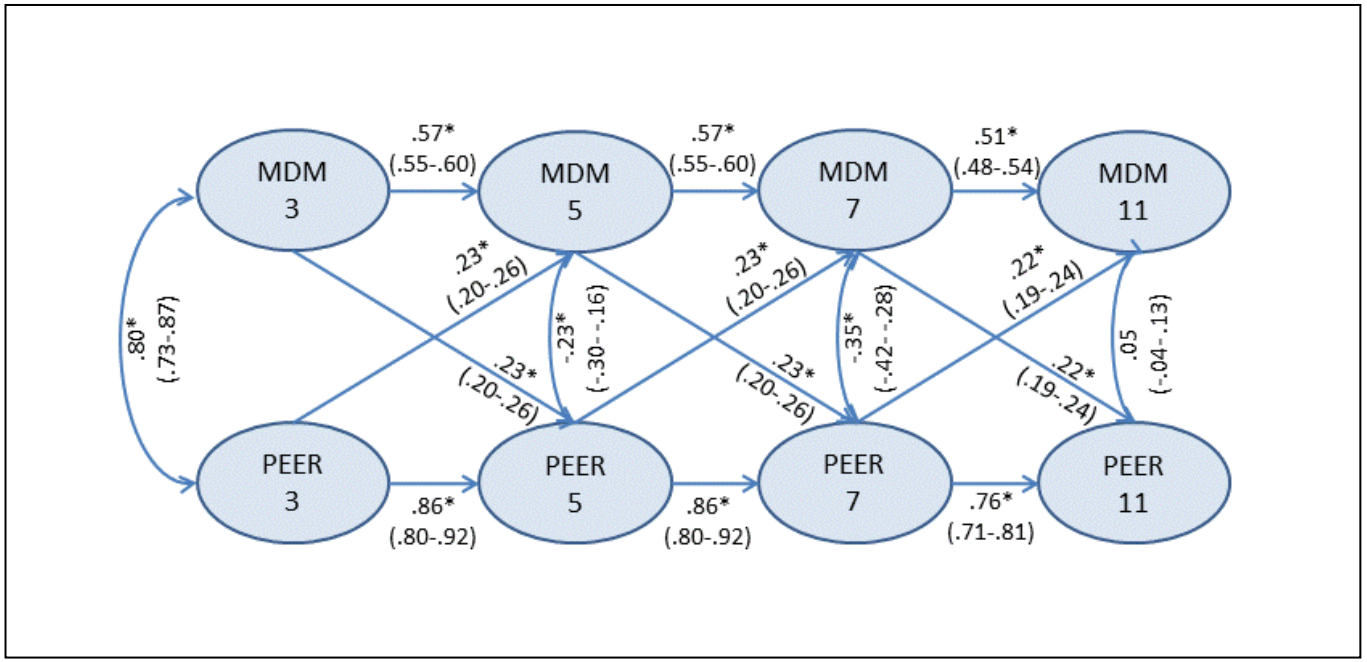


Table 3.6: Autoregressive cross-lagged model for maternal depressed mood (MDM) and peer problems (PEER), r = within-time correlation, n = 16,941 (unconditional), n = 16,301 (f: 7966; m: 8335) multigroup.

Model	No.	Equality constraints	X^2	df	Test	ΔX^2	Δdf	CFI	RMSEA
CFA		8 factor CFA	4386.31	808				.988	.016
Unconditional	1	Partial strong invariance across time	16821.31	899	1-v-CFA	6974.98	91	.946	.032
	2a	DEP->DEP (age 3-5, 5-7)	17746.48	900	2a-v-1	290.21	1	.943	.033
	2b	PEER -> PEER (age 3-5, 5-7)	16773.02	900	2b-v-1	1.61	1	.946	.032
	2c	DEP & PEER (age 3-5, 5-7)	17710.48	901	2c-v-2a	15.26	1	.943	.033
			17710.48	901	2c-v-2b	302.85	1	.943	.033
	3a	DEP & PEER; Child effects (PEER -> DEP)	17667.15	902	3a-v-2c	57.79	1	.943	.033
	3b	DEP & PEER; Parent effects (DEP -> PEER)	17626.68	902	3b-v-2c	20.26	1	.943	.033
	3c	DEP & PEER; Child & parent effects	17544.55	903	3c-v-3a	8.49	1	.943	.033
			17544.55	903	3c-v-3b	43.91	1	.943	.033
	4	DEP & PEER; Child effects = parent effects	17306.16	905	4-v-3c	63.72	2	.944	.033
Multigroup	5a	Model 4 & configural invariance (gender)	16615.85	1810				.946	.032

	5b	Model 4 & metric invariance (gender)	15881.22	1819	5b-v-5a	27.57	9	.949	.031
	5c	Model 4 & strong invariance (gender)	15267.68	1925	5c-v-5b	74.40	106	.952	.029
	6a	DEP->DEP (age 3-5, 5-7)	14987.50	1927	6a-v-5c	1.64	2	.953	.029
	6b	PEER->PEER (age 3-5, 5-7)	15133.08	1927	6b-v-5c	6.55	2	.952	.029
	6c	DEP & PEER (age 3-5, 5-7)	14755.14	1929	6c-v-6a	8.73	2	.953	.029
			14755.14	1929	6c-v-6b	4.27	2	.953	.029
	7	DEP & PEER; Child effects = parent effects	14455.57	1931	7-v-6c	13.18	2	.955	.028
	8a	DEP & PEER; Child effects = parent effects; r (age 3)	13843.11	1932	8a-v-7	0.55	1	.957	.028
	8b	DEP & PEER; Child effects & parent effects; r (all)	12713.63	1935	8b-v-8a	6.08	3	.961	.026

Figure 3.4: Standardized autoregressive cross-lagged model of maternal depressed mood (MDM) and peer problems (PEER). n = 16,301 (f: 7966; m: 8335). * p < .0001.



3.4 Discussion

The current study examined reciprocity between MDM and child conduct, hyperactivity, emotional and peer problems. The MCS provides an excellent test bed, with four repeated measures of mother and child behaviours covering the 8 year interval from age 3 to age 11. Partial strong measurement invariance across time and strong measurement invariance across gender was demonstrated indicating that child age at time of assessment and gender did not influence operationalization of the measurement scales. At each assessment significant positive bidirectional effects between MDM and all child behaviours were observed. There was no evidence that these varied across developmental period, or gender and the effects of MDM on child behaviour were equal to the effects of child behaviour on MDM. However results also suggested differences in the strength of the relationships between MDM and internalizing compared to externalizing behaviours.

The magnitude of bidirectional effects from age 3 to age 5 were equal to those observed from age 5 to age 7. While effects spanning equal developmental periods were fixed to equality, those observed from age 7 to age 11 were not fixed because of the larger age gap of 4 rather than 2 years. Age 7 to age 11 effects were however noted to be very similar to effects observed across younger age ranges with highly overlapping confidence intervals. The similarity in magnitude across the age 3 to age 11 range extend findings from previous studies that have reported effect equality across more limited developmental periods including age 4 to age 7 (Bagner et al., 2013) and from age 3 to age 6 (Harvey & Metcalfe, 2012).

A meta-analytic review of 193 studies that examined the relationship between MDM and child psychopathology reported that younger children were more vulnerable to the detrimental effects of MDM (Goodman et al., 2011). The current study however suggests that the effects of MDM on child behaviours were not moderated by child age. The present findings replicate those of Elgar and colleagues who also reported that the relationship between MDM and the hyperactivity, aggression and child emotional problems of 4 to 11 years olds were not moderated by age (Elgar et al., 2003).

Gender differences in the ACL models were examined, but observed effects were not significantly different for boys and girls for the measurement and structural part of the model. This indicates that MDM influences the behaviour of girls and boys similarly and equally, associations between child behaviour and later MDM do not differ for mothers of sons or daughters. This suggests that mechanisms involved in the intergenerational transmission of psychopathy such as genetic heritability, exposure to environmental risk factors such (e.g. harsh or inconsistent discipline), or socialization processes, are similarly experienced by boys and girls. Gender did not moderate the effects of MDM on externalizing behaviours in Goodman's meta-analytic review, but it did moderate the relationship between MDM and internalizing behaviours, with girls of depressed mothers being more likely to exhibit internalizing behaviours compared to boys (Goodman et al., 2011). In the current study, gender differences were examined step-by-step for each causal path, with no indication of moderating effects relative to any domain of child behaviour. ACL models control for previous measures of child internalizing problems and their effects on MDM which may attenuate gender-specific moderation. Current findings are consistent with other reciprocal studies that reported no gender differences in the relationships between MDM and internalizing or externalizing behaviours (Bagner et al., 2013; Elgar et al., 2003).

Equality of parent and child effects indicated that parent and child represent mutual risk factors for each other's psychopathologies. Inconsistent findings were reported in previous bidirectional studies regarding the magnitude of parent and child effects. While one study reported stronger effects of MDM on both internalizing and externalizing domains of child behaviour (Nicholson et al., 2011), effect magnitude differed according to the domain being examined. In Elgar's study, child effects were stronger for internalizing behaviours, thus emotional problems had a stronger effect on MDM, but parent effects were stronger for externalizing indicating that MDM predicted child aggression and hyperactivity more strongly (Elgar et al., 2003). In another study, MDM had a stronger effect on the developing internalizing problems of both sexes and on boys' antisocial behaviour, but effects were equal for girls' antisocial behaviour (Jaffee and Poulton, 2006). It is possible that the large MCS sample used in the current study affords sufficient power to identify effects more consistently than is possible in smaller studies.

Finally, larger cross-lagged estimates are reported between MDM and internalizing behaviours compared to externalizing behaviours which suggest that childhood emotional and peer problems are more affected by, and likewise affect MDM more than is the case for hyperactivity or conduct problems. Reciprocity appears distinctly weaker between MDM and hyperactivity than internalizing problems. An important caveat to this finding is that MDM was modelled with each child behaviour separately in the current study, thus indications that bidirectional effects were weaker for MDM and externalizing behaviours are derived from examination of confidence intervals across different models. Consistent with current findings, Elgar and colleagues observed quantitative differences in the relationship between clinically significant levels of psychopathologies. Specifically, child emotional problems predicted

increased MDM more strongly than child hyperactivity or aggression, and likewise MDM predicted increased child emotional problems more than it did hyperactivity or aggression (Elgar et al., 2003).

Reported differences suggest that there may be different aetiological pathways to internalizing compared to externalizing difficulties for children of depressed mothers. Children of depressed mothers are more likely to experience socio-emotional difficulties (Breaux et al., 2013; Yan & Dix, 2013). Evidence suggests that MDM may be more closely associated with internalizing problems and withdrawal for offspring (Wang & Dix, 2013; Yan & Dix, 2013). MDM has been found to disrupt parenting with adverse socio-emotional and behavioural outcomes (Dallaire et al., 2006; Dix & Meunier, 2009; Lovejoy et al., 2000).

A number of findings support the notion that disrupted parenting may have a stronger relationship to internalizing problems. Parenting characteristics such as warmth, hostility, withdrawal or sensitivity, are likely to mediate the relationship between MDM and internalizing and externalizing problems and may underpin reciprocity between MDM and child EBDs. A study that examined trajectories of MDM from 1 month to 7 years reported that high levels of MDM were frequently observed to co-occur with low levels of maternal sensitivity, however in some trajectories increased sensitivity was observed to occur alongside reduced MDM, with resulting improvements in mothers-child interactions as rated by independent observers (Campbell et al., 2007). This suggests a transactional and reciprocal relationship in which reduced MDM and co-occurring elevated maternal sensitivity was associated with improved social competencies of the child. Future studies might also examine features of MDM that are likely to influence the intergenerational transmission of psychopathies. Depressed and irritable mothers may be more inclined towards harsh

discipline, and may subsequently influence a tendency towards externalizing in offspring, while depressed and withdrawn mothers may be more inclined towards avoidance and inadvertently influence a more internalizing style in children. Equally, it is possible that children with a propensity towards externalizing behaviours may evoke a more hostile parenting style, and children who tend more towards internalizing may influence a withdrawn style of parenting from depressed mothers.

3.4.1 Implications

Co-occurring MDM and childhood EBDs has important implications for prevention and treatment. Reciprocity indicates that both parties inadvertently maintain psychological symptoms within the context of difficult mother-child relationship. The psychological impact of each is consistent and equal in magnitude across childhood. Improving the psychological wellbeing of one member of the dyad will have a positive influence on the other (Shaw, Connell, Dishion, Wilson, & Gardner, 2009). Implications of the current study are two-fold. First, clinicians treating maternal depression or childhood EBDs should identify if symptoms are being maintained within the context of a negative reciprocal relationship. Second, interventions aimed at improving the psychological wellbeing of both mother and child simultaneously are likely to ameliorate symptoms for both.

3.4.2 Limitations

Findings should be interpreted within the context of the limitation that mothers reported on both their depressed mood and their child's behaviour. While mothers provide an important perspective in clinical decision making regarding child behaviours, using a single reporter means that common method variance might inflate the associations between constructs (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Replication of these results in studies that employ multiple raters at each time point would be of benefit.

3.4.3 Conclusions

Evidence of reciprocity in MDM and child behaviours enhances knowledge on the relationship between mother and child psychopathologies across childhood, and supports the idea that mother and child psychopathologies are both interrelated and interdependent. However although ACL models indicate behavioural progression of mother and child through autocorrelations, they do not address questions about how these behaviours change over time and importantly, how change in one behaviour influences change in the other over time. Thus examination of how mother and child trajectories change together over time will extend the current study and enrich our understanding of how mother and child psychopathologies relate across childhood.

Chapter 4: Change in mother and child behaviours across childhood

4.1 Introduction

In Chapter 3 reciprocity was reported between mother and all child behaviours that was equal across developmental stage, child gender, and agent. The evidence also indicated distinct, stronger relationships between MDM and internalizing behaviours, compared to those between MDM and externalizing behaviours. While reciprocity was confirmed from age 3 to age 11, development in the level of behaviours was not examined. Chapter 4 examines change in co-occurring MDM and childhood emotional and behavioural problems from age 3 to age 11, and assesses how change in mother and child behaviours is related. Applying latent growth curve (LGC) modelling techniques to repeated measures of behavioural constructs enables examination of features of development, including initial levels, rate and shape of change. Associations between multiple behaviours can be assessed with parallel process growth models (PPGMs), enabling the evaluation of relationships between change in MDM and dimensions of child behaviour.

Relatively few studies have explicitly measured how changes in mother and child behaviours are related to one another during childhood. One study, which investigated the relationship between MDM and the aggressive behaviours of boys from low-income families from age 5 to age 10, reported significant decline in both over the period. Moreover, statistically significant positive correlations between the respective linear growth factors indicated that that declines in one behaviour were matched with declines in the other across the period, although for mothers with high initial levels of MDM, change in their son's aggressive

behaviours was slower (Gross et al., 2008). Another study that used a sample of 1 to 9 years olds and their mothers reported that initial levels of MDM were significantly positively associated with child externalizing behaviours at age 9 and change over time, thus for mothers high in depression, increases in problematic child behaviours was faster over the period. Change in MDM was positively related to change in externalizing behaviours, but only for children with avoidant-insecure attachment (Munson et al., 2001). Another study examined the relationship between MDM and externalizing behaviours from age 2 to age 10 and reported that the rate of decline in MDM and child externalizing behaviours across the period was significantly correlated (Henninger & Luze, 2013).

Although these studies indicate interdependence of change over time in MDM and child externalizing behaviours, this has not been consistently observed. In a study that investigated change in oppositional behaviours and MDM from age 2 to age 5, no significant associations were reported between changes in these behaviours. (Choe et al., 2014). To date, no studies have addressed the question of how changes in MDM and internalizing behaviours influence one another over time.

To extend the research in this area, this study will examine associations between change in MDM and dimensions of child externalizing behaviours, and will be the first to explore change in MDM and child internalizing behaviours. Initial levels and change in mother and child behaviours are hypothesized to be significantly related from age 3 to age 11.

4.2 Method

This study employed the same Millennium Cohort Study sample and the same measures of MDM and child emotional and behavioural problems assessed at ages 3, 5, 7 and 11 as described in Chapter 3.

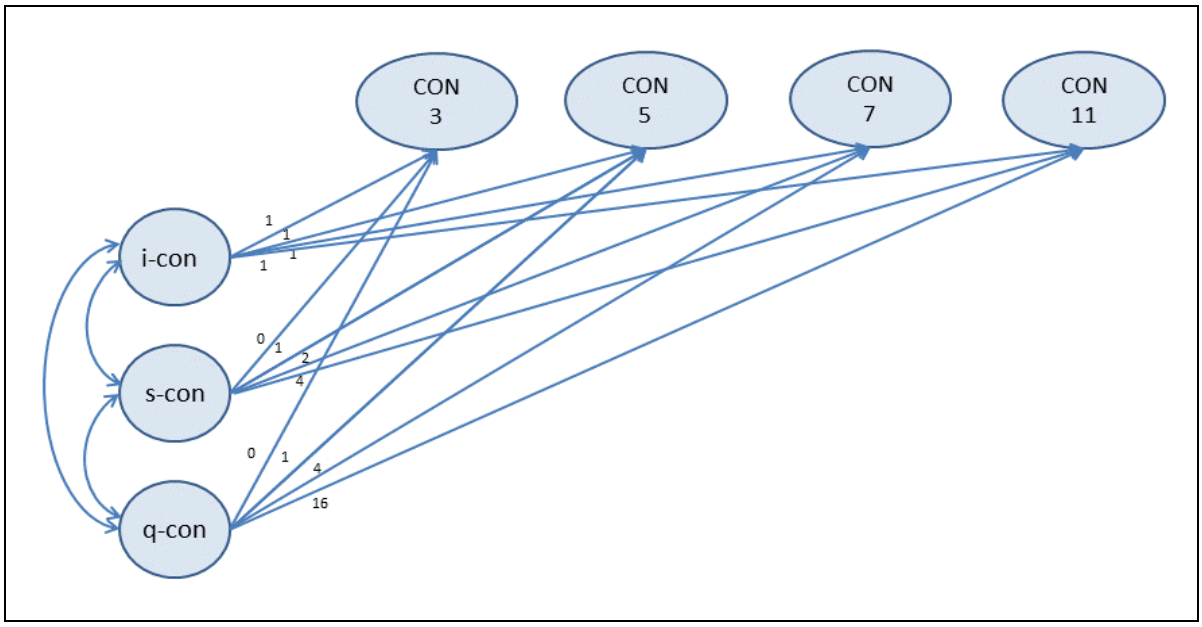
4.2.1 Analysis

In previous chapters the stability of the measurement structure of the MDM and SDQ subscales were first assessed across time, and was then assessed across gender while across time constraints were applied. In these analyses gender invariance in the measurement structure of MDM and SDQ scales was assessed without prior across time constraints.

Next, across-time constraints were applied to the measurement model of the MDM and SDQ factors based on the results of measurement invariance across time reported in Chapter 3. MDM was modelled with each SDQ subscale separately. To obtain standardized estimates, factor means were set at zero and factor variances were set at 1. Residual variance of equivalent items were correlated and correlations were constrained to be equal over 2 or 4 year intervals. Growth factors were then added in incremental stages to form second order latent growth curves (i.e. growth factors represent the second order of latent variables, while the behavioural constructs each with their respective observed indicators, represent the first order of latent variables). First, an intercept factor was added to model initial levels of behaviours. Due to the categorical nature of the items, the mean of the intercept was fixed at zero. Factor loadings were fixed at 1 at each time-point (Figure 1). A model in which the intercept variance was fixed at zero (Model 2a) was compared to one in which intercepts were allowed to vary between individuals (Model 2b).

This process was repeated for the remaining linear (slope) and non-linear (quadratic) growth factors. A slope growth factor was added to assess rate of change with factor loadings fixed at 0 (age 3), 1 (age 5), 2 (age 7) and 4 (age 11) to capture linear growth, recognising the uneven interval between assessments. A model in which the variance of the linear slope factors was fixed to zero (Model 3a) was compared to one in which individual variance in slope was estimated (Model 3b). Finally, a quadratic growth factor was added to capture curvilinear growth with factor loadings fixed at 0 (age 3), 1 (age 5), 4 (age 7) and 16 (age 11). Again a model in which the variance of the quadratic growth factor was fixed to zero (Models 4a) was compared to a model in which the variance was estimated (Model 4b).

Figure 4.1: Illustration of latent growth curve specification of child conduct problems (CON) measured at age 3, 5, 7 and 11. Growth factors represent intercept (starting value; i-con), slope (linear growth; s-con) and quadratic (non-linear growth; q-con) change over time.



In the next stage, second order PPGMs were fitted to assess change in MDM and child behaviours simultaneously. Each MDM-SDQ combination was examined separately. To do so, each of the growth factors were correlated with one another. Thus intercept, slope and quadratic growth curve factors for MDM were correlated with one another, and also correlated with the intercept, slope and quadratic factors associated with the child behaviours. The same software and estimators were used for data analyses, and the same criteria were used to assess models based on the goodness-of-fit indices as described in Chapter 3.

4.3 Results

4.3.1 Measurement invariance

Measurement invariance of the MDM and SDQ subscales was tested across gender (Table 4.1). Imposing measurement constraints (i.e. fixing factor loadings and thresholds to be equal across gender) did not significantly reduce model fit indicating the measurement of behavioural constructs did not differ by gender.

Table 4.1: Results of measurement invariance across gender. FLs = factor loadings. Bold indicates preferred model. n=16,288.

Construct	Model	Constraints	X^2	Df	CFI	RMSEA
Maternal depressed mood	Configural	None	2072.69	456	.993	.021
	Metric	FLs	2096.06	476	.993	.021
	Strong	**Thresholds**	**2016.15**	**544**	**.993**	**.018**
Conduct	Configural	None	1122.63	286	.984	.019
	Metric	FLs	1139.68	302	.984	.018
	Strong	**Thresholds**	**1125.66**	**318**	**.984**	**.018**
Hyperactivity	Configural	None	6139.36	292	.953	.050
	Metric	FLs	6087.09	308	.953	.048
	Strong	**Thresholds**	**5927.67**	**324**	**.955**	**.046**
Emotional problems	Configural	None	1142.48	298	.980	.019
	Metric	FLs	1255.86	314	.978	.019
	Strong	**Thresholds**	**1235.96**	**330**	**.979**	**.018**
Peer problems	Configural	None	1863.09	298	.956	.025
	Metric	FLs	1758.41	314	.960	.024
	Strong	**Thresholds**	**1724.14**	**330**	**.961**	**.023**

4.3.2 Change over time

In the next stage of analysis, intercept, slope and quadratic growth factors were fitted in turn to the best fitting measurement models for MDM and SDQ subscales applying the across time measurement constraints derived in Chapter 3. First, univariate LGCs were fitted

separately for each subscale (Tables 4.2 - 4.6). MDM was best represented with intercept and linear growth factors indicating linear change over time (Table 4.2; Figure 4.2). Adding a quadratic growth factor did not significantly improve fit (<.01 increase in CFI). Therefore the more parsimonious intercept and linear growth factor model (Model 3b) was selected. Intercept growth factor mean score were fixed at zero and significant variance was observed in initial levels (variance (V) = 2.10); linear change showed a significant average increase in MDM over time (slope mean (M) = 0.13) and there was significant variance (V = .03) around the slope mean.

For all child behaviours, curvilinear change over time was demonstrated with best fitting models that incorporated intercept, slope and quadratic growth factors. Negative mean scores for the linear growth factor indicated overall decline in problem behaviours across all SDQ subscales. Each subscale also demonstrated significant variance in initial levels and rate of change in conduct problems (Table 4.3), hyperactivity (Table 4.4), emotional problems (Table 4.5), and peer problems (Table 4.6). Finally, significant quadratic means scores and variance indicate significant curvilinear change over time in conduct problems (Figure 4.3), hyperactivity (Figure 4.4), emotional problems (Figure 4.5), and peer problems (Figure 4.6).

As expected, linear and quadratic growth factors were highly correlated in the PPGMs. Linear growth factors explain the relationship between the behaviour and time, whereas quadratic factors is the relationship between the behaviour and time squared. As such, growth factor loadings are the same for the first two measures: both the linear and quadratic growth factors load onto the behavioural latent factors with a factor loading of 0 at time 1 and a factor loading of 1 at time 2, however factor loadings increase to 2 and 4 for times 3 and 4 for the linear growth factor and increase to 4 and 16 at times 3 and 4 for the quadratic factor (see

Figure 4.1). Although this results in the linear and quadratic factors being confounded, the quadratic factor explains change over time in behaviour beyond that which is explained by the linear growth factor. In addition, when a steep linear change is followed by a flattening off due to a natural asymptote, the flattening off can appear more sudden and result in a sharper curvature of change. This is likely to make linear and quadratic factors more related.

Table 4.2: Results of univariate latent growth curves for maternal depressed mood. Bold indicates preferred model. (-v) = estimated mean score only, variance has been fixed at zero. n = 16768 * p < .0005

								Intercept		Slope		Quadratic	
Construct		Model	Comp	X2	df	CFI	RMSEA	M	V	M	V	M	V
Maternal depressed mood	2a	Intercept (-v)	2a v 2b	66160.03	267	.711	.121	0	0				
	2b	Intercept	2b v 3b	2348.38	266	.991	.022	0	1.70*				
	3a	Intercept, Slope (-v)	3a v 3b	1983.65	265	.992	.020	0	1.70*	0.12*	0		
	3b	**Intercept, Slope**	**3b v 4b**	**1834.15**	**263**	**.993**	**.019**	**0**	**1.90***	**0.13***	**0.03***		
	4a	Intercept, Slope, Quadratic (-v)	4a v 4b	1811.08	262	.993	.019	0	1.90*	0.00	0.03*	0.03*	0
	4b	Intercept, Slope, Quadratic		1679.07	259	.994	.018	0	2.10*	0.00	0.24	0.03*	0.01

Figure 4.2: Linear change in maternal depressed mood from age 3 to 11

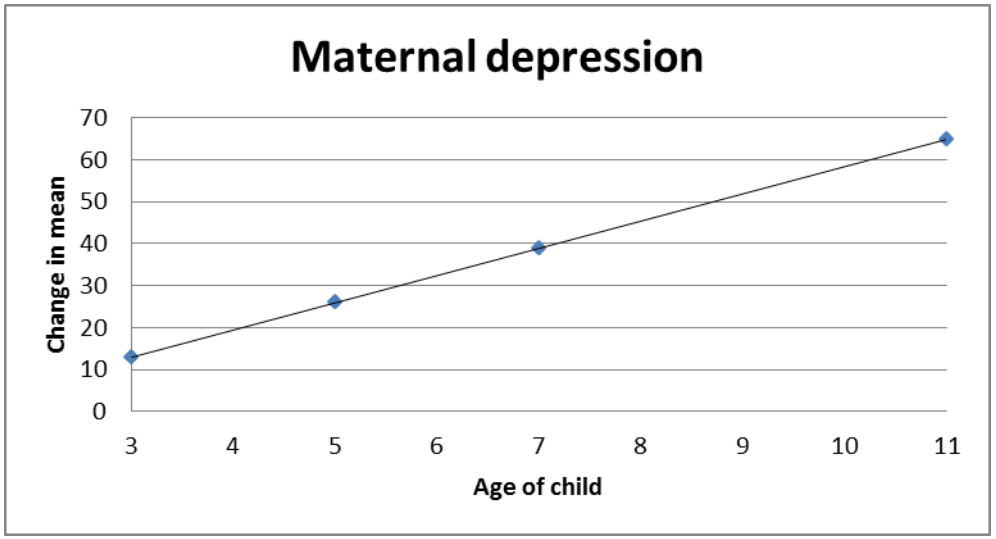


Table 4.3: Results of univariate latent growth curves for conduct problems. Bold indicates preferred model. n = 16928 * p < .0005

								Intercept		Slope		Quadratic	
Construct		Model	Comp	X2	Df	CFI	RMSEA	M	V	M	V	M	V
Conduct problems	2a	Intercept (-v)	2a v 2b	20754.19	170	.610	.085	0	0				
	2b	Intercept	2b v 3b	2046.87	169	.964	.026	0	2.17*				
	3a	Intercept, Slope (-v)	3a v 3b	1820.16	168	.969	.024	0	2.35*	-0.18*	0		
	3b	Intercept, Slope	3b v 4b	1426.29	166	.976	.021	0	2.93*	-0.21*	0.12*		
	4a	Intercept, Slope, Quadratic (-v)	4a v 4b	1179.99	165	.981	.019	0	2.93*	-0.98*	0.12*	0.17*	0
	4b	**Intercept, Slope, Quadratic**		**1084.53**	**162**	**.983**	**.018**	**0**	**4.40***	**-1.17***	**1.46***	**0.21***	**0.06***

Figure 4.3: Non-linear change in child conduct problems from age 3 to 11

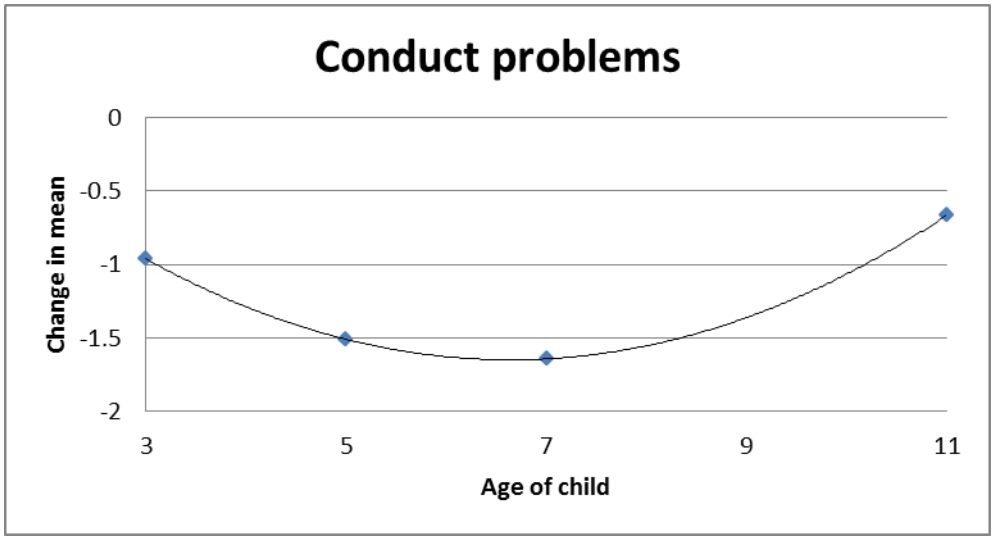


Table 4.4: Results of univariate latent growth curves for hyperactivity. Bold indicates preferred model. n = 16929 * p < .0005

								Intercept		Slope		Quadratic	
Construct		Model	Comp	X2	Df	CFI	RMSEA	M	V	M	V	M	V
Hyperactivity	2a	Intercept (-v)	2a v 2b	60336.86	181	.543	.140	0	0				
	2b	Intercept	2b v 3b	9093.35	180	.932	.054	0	2.38*				
	3a	Intercept, Slope (-v)	3a v 3b	8078.75	179	.940	.051	0	2.38*	-0.17*	0		
	3b	Intercept, Slope	3b v 4b	7370.77	177	.945	.049	0	2.84*	-0.20*	0.09*		
	4a	Intercept, Slope, Quadratic (-v)	4a v 4b	7138.98	176	.947	.048	0	2.83*	-0.48*	0.09*	0.07*	0
	4b	**Intercept, Slope, Quadratic**		**6267.58**	**173**	**.953**	**.046**	**0**	**3.85***	**-0.58***	**1.15***	**0.09***	**0.04***

Figure 4.4: Non-linear change in child hyperactivity from age 3 to 11

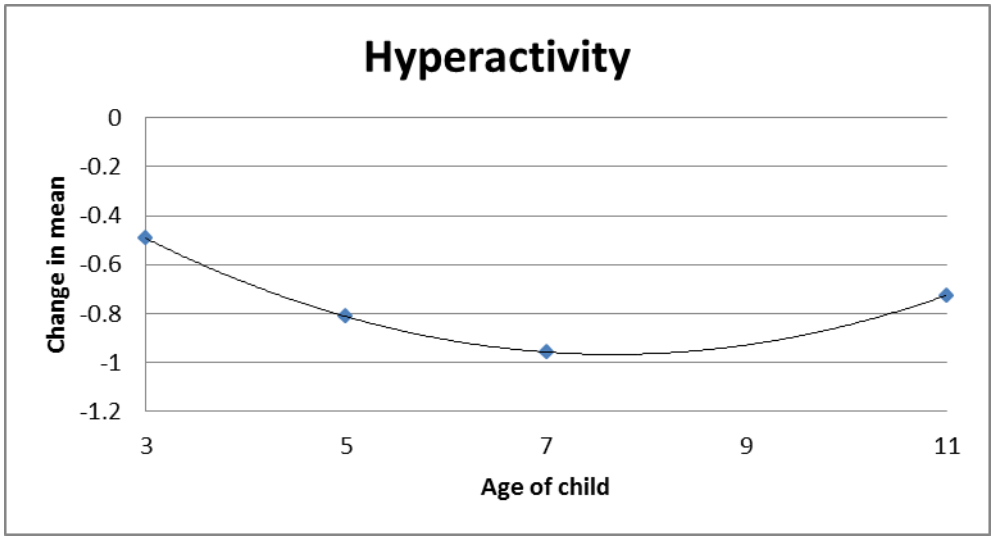


Table 4.5: Results of univariate latent growth curves for emotional problems. Bold indicates preferred model. n = 16928 * p < .0005

								Intercept		Slope		Quadratic	
Construct		Model	Comp	X2	Df	CFI	RMSEA	M	V	M	V	M	V
Emotional problems	2a	Intercept (-v)	2a v 2b	14223.58	167	.695	.070	0	0				
	2b	Intercept	2b v 3b	1811.78	167	.964	.024	0	1.32*				
	3a	Intercept, Slope (-v)	3a v 3b	1814.44	166	.964	.024	0	1.32*	0.00	0		
	3b	Intercept, Slope	3b v 4b	1266.49	164	.976	.020	0	1.55*	0.00	0.07*		
	4a	Intercept, Slope, Quadratic (-v)	4a v 4b	1252.61	163	.976	.020	0	1.55*	-0.13*	0.07*	0.03*	0
	4b	**Intercept, Slope, Quadratic**		**976.27**	**160**	**.982**	**.017**	**0**	**2.07***	**-0.14***	**0.83***	**0.04***	**0.03***

Figure 4.5: Non-linear quadratic change in child emotional problems from age 3 to 11

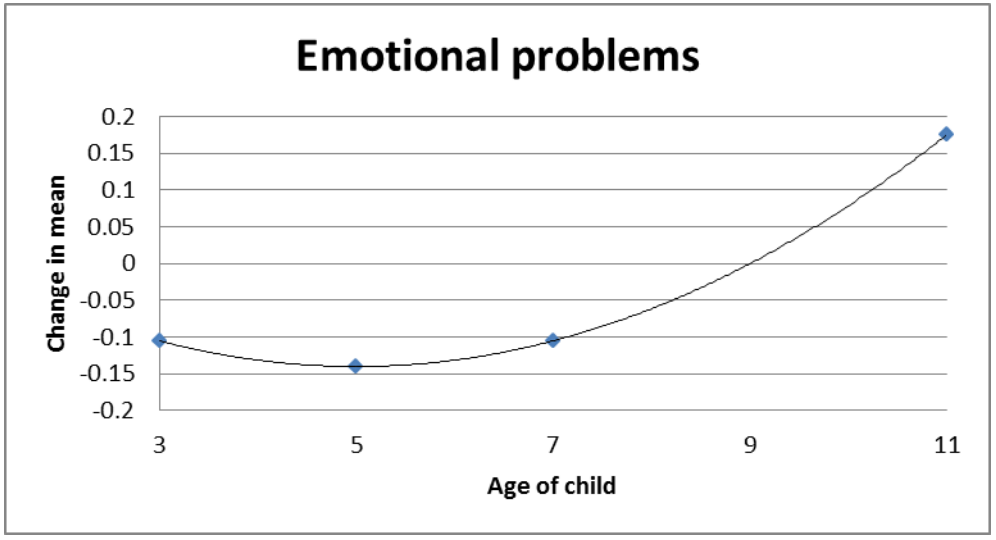
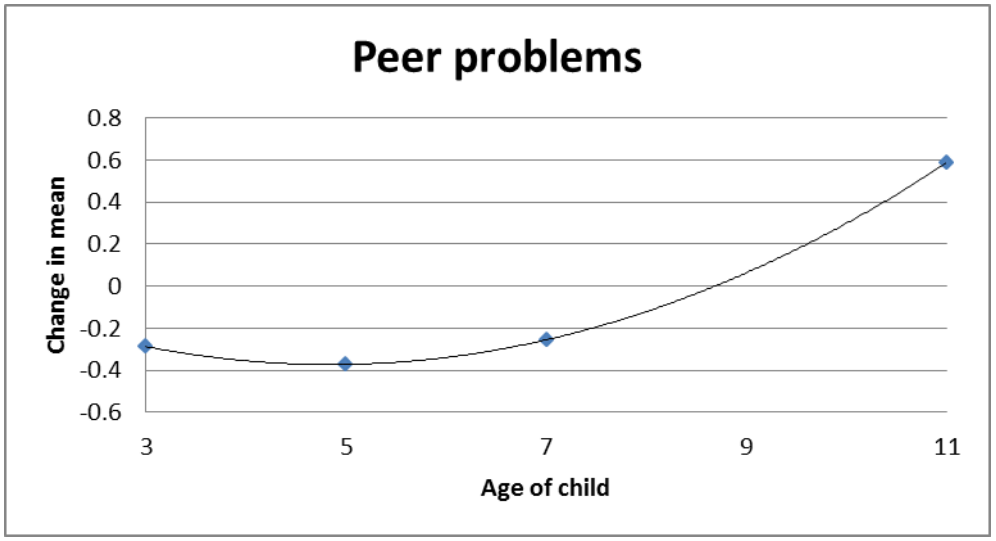


Table 4.6: Results of univariate latent growth curves for peer problems. Bold indicates preferred model. n = 16928 * p < .0005

								Intercept		Slope		Quadratic	
Construct		Model	Comp	X2	Df	CFI	RMSEA	M	V	M	V	M	V
Peer problems	2a	Intercept (-v)	2a v 2b	12813.59	168	.673	.067	0	0				
	2b	Intercept	2b v 3b	3186.20	167	.922	.033	0	1.60*				
	3a	Intercept, Slope (-v)	3a v 3b	3202.57	165	.921	.033	0	1.60*	0.02	0		
	3b	Intercept, Slope	3b v 4b	2125.16	164	.949	.027	0	1.71*	0.02	0.11*		
	4a	Intercept, Slope, Quadratic (-v)	4a v 4b	2059.30	163	.951	.026	0	1.71 *	-0.32*	0.11*	0.08*	0
	4b	**Intercept, Slope, Quadratic**		**1746.49**	**160**	**.959**	**.024**	**0**	**2.45***	**-0.39***	**1.47***	**0.10***	**0.07***

Figure 4.6: Non-linear quadratic change in child peer problems from age 3 to 11



4.3.3 Parallel process growth models (PPGMs)

Using the univariate second order LGC models from the previous stage, second order PPGMs were fitted by correlating all growth factors within and across behaviour. Again, MDM-SDQ combinations were examined separately. All PPGMs provided good fit for the observed data with CFI values greater than .95 (Table 4.7). The means and variances for each of the scales were commensurate with those observed in LGC models. Several significant correlations were observed between initial levels, linear and quadratic growth factors for MDM and conduct problems (Table 4.8), hyperactivity (Table 4.9), emotional problems (Table 4.10) and peer problems (Table 4.11) growth factors.

Initial levels of MDM were significantly positively correlated with initial levels of all child behaviour measures, illustrating the correlation between maternal depressed mood and emotional and behavioural problems at age 3. Linear change over time in MDM was negatively correlated with initial levels of conduct problems and hyperactivity. This indicates that increases in MDM over time were slower for mothers of children high in conduct problems and hyperactivity. Initial levels of MDM were significantly positively correlated with rate of change in peer problems suggesting that the decline in peer problems was slower for children of depressed mothers. Linear change in MDM was not related to initial levels or rate of change in child emotional problems.

Table 4.7: Fit indices for unconditional parallel process growth models including means (M) and variances (V) for growth factors for for maternal depressed mood (MDM) and child behaviours, including conduct (CON), hyperactivity (HYP), emotional (EMO) and peer (PEER) problems. All estimates are significant at a $p < .0005$ level, n = 16,941.

					MDM				Child behaviours					
					Intercept		Slope		Intercept		Slope		Quadratic	
Model	X2	df	CFI	RMSEA	M	V	M	V	M	V	M	V	M	V
MDM-CON	3444.17	899	.990	.013	0	1.90	0.13	0.03	0	4.38	-1.18	1.47	0.21	0.06
MDM-HYP	8060.69	910	.977	.022	0	1.90	0.13	0.03	0	3.89	-0.58	1.17	0.09	0.04
MDM-EMO	4163.19	897	.988	.015	0	1.90	0.13	0.03	0	2.05	-0.15	0.82	0.04	0.03
MDM-PEER	11319.44	909	.965	.026	0	1.90	0.18	0.03	0	2.66	-0.40	1.56	0.14	0.07

Table 4.8: Correlations between maternal depressed mood (MDM) and conduct problems (CON) second order parallel process growth model.

I = intercept, S = linear (slope), Q = curvilinear (quadratic). n = 16,941 * p < .0005

	I-MDM	S-MDM	I-CON	S-CON
I-MDM	-			
S-MDM	-0.14*	-		
I-CON	0.51*	-0.22*	-	
S-CON	0.10	0.29	-0.16*	-
Q-CON	-0.15	0.01	0.12	-0.93*

Table 4.9: Correlations between maternal depressed mood (MDM) and hyperactivity (HYP) second order parallel process growth model.

I = intercept, S = linear (slope), Q = curvilinear (quadratic). n = 16,941 * p < .0005

	I-MDM	S-MDM	I-HYP	S-HYP
I-MDM	-			
S-MDM	-0.14*	-		
I-HYP	0.41*	-0.16*	-	
S-HYP	0.05	0.21	-0.14*	-
Q-HYP	-0.10	0.05	0.04	-0.94*

Table 4.10: Correlations between maternal depressed mood (MDM) and emotional problems (EMO) second order parallel process growth model.

I = intercept, S = linear (slope), Q = curvilinear (quadratic). n = 16,941 * p < .0005

	I-MDM	S-MDM	I-EMO	S-EMO
I-MDM	-			
S-MDM	-0.14*	-		
I-EMO	0.57*	-0.16	-	
S-EMO	0.11	0.16	-0.12	-
Q-EMO	-0.16	0.18	0.01	-0.92*

Table 4.11: Correlations between maternal depressed mood (MDM) and peer problems (PEER) second order parallel process growth model.

I = intercept, S = linear (slope), Q = curvilinear (quadratic). n = 16,941 * p < .0005

	I-MDM	S-MDM	I-PEER	S-PEER
I-MDM	-			
S-MDM	-0.15*	-		
I-PEER	0.49*	-0.11	-	
S-PEER	0.20*	0.09	-0.01	-
Q-PEER	-0.22*	0.12	-0.04	-0.92*

4.4 Discussion

This aim of this chapter was to assess the interrelatedness of MDM with the conduct, hyperactivity, emotional and peer problems of children using LGC techniques to model change in behaviours across time. Mother and child behaviours were expected to be interrelated, and it was hypothesized that change in behaviours would be significantly correlated across the dyad. As expected, significant positive correlations between initial rates of MDM and all the child behaviours were reported, indicating that mothers with high levels of MDM were more likely to have children with increased internalizing and externalizing problems, confirming the interrelatedness of psychopathologies.

Examination of the PPGM correlations suggest a strong relationship between between MDM and externalizing behaviours. Specifically, negative correlations between rate of change in MDM and both initial levels of conduct problems and hyperactivity indicated that increases in MDM across childhood were slower for mothers of children high in externalizing behaviours. This finding is quite unexpected considering that declines in externalizing behaviours were slower for children with higher initial levels of externalizing problems. One possibility is that the relationship is a product of the positive correlations of the conduct problems and hyperactivity intercepts with the intercept of MDM, and the negative relationship between MDM intercept and slope. In this explanation, mothers of children with high initial levels of conduct problems or hyperactivity also have high initial levels of MDM, and mothers with high levels of MDM to start with tend to have shallower increases in MDM across time, in part due to a ceiling effect of the measurement scale, in part due to a natural regression to the mean. Another possibility is that continued high levels of externalizing behaviours across childhood may lead mothers to become more withdrawn from the relationship and thereby less influenced by the difficult behaviours of their children.

Alternatively, mothers may become more accustomed to persistently high rates of externalizing behaviours, viewing them as more characteristic to the child. This may be more likely if disruptive children also have a difficult temperament (e.g. low effortful control or high negative emotionality), which is a more stable personality trait, and has been associated with more disruptive behaviours (Gross et al., 2009; Grazyna Kochanska & Kim, 2013).

The evidence relating to externalizing difficulties indicate that levels of child behaviours at age 3 influence the unfolding MDM across childhood. Children with higher levels of disruptive behaviours have mothers whose depressive symptoms incline at a slower rate which demonstrates the enduring effect that externalizing behaviours have on the depressive symptoms of their mothers. However, although this association may appear to improve relations (i.e. slower increase in depressive symptoms) it is important not to make spurious assumptions as mother and child behaviours occur relative to one another, so although increase in MDM is slower, initial levels are high and continue to rise. Furthermore, the apparent reduced impact of externalizing behaviours may be indicative of detrimental mechanisms in the mother-child relationship such as maternal withdrawal or reduced sensitivity to one another.

This is the first study to examine the relationship between change in MDM and change in the internalizing problems of children. Although positively correlated initial rates of MDM and both dimensions of internalizing behaviours were observed, change in MDM was not related to either intercept or slope of children's emotional or peer problems. However, a novel finding of a significant positive correlation between initial levels of MDM and slower decline in peer problems was reported. This suggests that offspring of depressed mothers experience more peer problems through lower rates of decline across childhood. It is possible that

disruptions to parenting caused by MDM impact child socialization making it more difficult for children of depressed mothers to successfully negotiate peer interactions or maintain peer relationships.

This novel finding suggests that MDM negatively impacts child socialization processes and impedes socio-emotional development as a result of disrupted parenting. Children of depressed mothers have frequently been reported to experience socio-emotional difficulties across childhood; exposure to MDM in infancy predicts deficits in socio-emotional development of 6 year olds (Wu et al., 2011). In addition, socio-emotional skills differentiated children of low- and high-functioning depressed mothers; while children of high-functioning depressed mothers had less problems in this area than children of low-functioning depressed mothers, they had more than children of mothers with no experience of depression (Wang & Dix, 2013).

MDM by contrast appears to have a more enduring relationship with child peer problems. Children of mothers high in MDM at age 3 have more peer problems across childhood evidenced by slower declines, thus although peer problems are reducing across the period, overall change is likey to be smaller relative to the mean rate of change. This may be explained by disruptions to parenting caused by MDM, but could also be an effect relating to disrupted socialization processes as a result of high levels of maternal depression in early childhood. It is intriguing that change in MDM and child emotional problems were not significantly associated in the parallel process model. This may be because change in emotional problems across the period was significant, but slight. It is possible that these dimensions of child behaviour have a different aetiology and represent alternative pathways to psychopathologies as a result of exposure to MDM.

4.4.1 Implications

The relationship between MDM and both internalizing and externalizing behaviours is highly complex. This study shows that initial levels of MDM was related to both the externalizing and internalizing behaviours of children, thus clinicians treating mother's depression or child EBDs should be mindful of negative mother-child relationships that may perpetuate symptoms in the home environment. Of particular clinical value is the finding that MDM has enduring consequences for child peer problems suggesting that MDM disrupts socio-emotional functioning.

4.4.2 Conclusions

The current study underscores quantitative differences between internalizing and externalizing problems in terms of how they relate to MDM. Change in MDM over time was only significantly associated with high initial levels of externalizing behaviours. Initial levels of MDM only impacted change over time in the peer problems dimension of internalizing behaviours. Change in MDM was not associated to change in the emotional problems of children.

Chapter 5: General Discussion

In this series of studies we have sought to examine the interrelatedness of MDM and child conduct, hyperactivity, emotional and peer problems in the general population. Research has robustly reported that MDM has an adverse influence on the socio-emotional development of children, which has been linked to emerging emotional and behavioural problems. Evidence also suggests that the problematic behaviour of children also has reciprocal adverse outcomes for maternal mood. Reciprocity between mother and child psychopathology was examined to assess features of the reciprocal mechanisms that drive this transactional relationship. Next, to examine how both mother and child behaviours change over time both independently, and in unison, trajectories were charted to assess the direction, linearity and rate of change across childhood.

The Millennium Cohort Study provided an excellent dataset with which to test associations across time. Over 19,000 families from England, Scotland, Wales and Northern Ireland participated in this birth cohort study of children born between September 2000 and August 2001. Sampling weights applied to the dataset attenuate for the over-representation of socially deprived and ethnically diverse families. Repeated measures of MDM (assessed using the Kessler 6 scale) and child emotional and behavioural problems (assessed with the preschool and school-aged SDQ) were obtained when children were aged 3, 5, 7 and 11 years old. To draw accurate inferences from the age 3 data, a validation study of the preschool SDQ was required to assess the psychometric properties of the modified version. The stability of the mother and child measurement structures was examined longitudinally to determine if the behavioural constructs were being detected consistently across time and across gender.

5.1 Summary of main findings

In the first study we examined the psychometric properties of the preschool SDQ relative to the school-aged equivalent which is a well-established measure of common forms of psychopathology in 4 to 16 year olds. This was the first study to examine the preschool SDQ longitudinally enabling examination of the stability of the measurement structure over time and predictive validity. The preschool version supported a 5 factor structure which diverged from other studies that recommended the 3 factor model of internalizing (emotional and peer problems), externalizing (conduct problems and hyperactivity) and prosocial behaviours (Dickey & Blumberg, 2004) for use with low-risk community samples and epidemiological studies (A. Goodman, Lamping, & Ploubidis, 2010). Internal consistency reliability was higher in our study than in previous studies which may reflect our methodological approach of assessing Cronbach's alpha in a SEM framework that accounted for the skewness of the categorical data. Reliability estimates assessed using McDonald's omega coefficient were consistent with the Spanish preschool validation study (Ezpeleta, Granero, La Osa, Penelo, & Domènech, 2013).

It was possible to examine the stability of the measurement structure of the SDQ through longitudinal analysis of age 3, 5 and 7 SDQ scores. If items are stable measures of a behavioural construct, they should be selected with some consistency across time. Thus items should load onto associated factors with relative consistency across time (i.e. factor loadings should not be significantly statistically different across age groups) and should have statistically similar threshold cut points when ordinal data are used (i.e. threshold cut points should not be significantly statistically different across age groups). All preschool subscales demonstrated metric invariance (factor loading invariance) over time, and conduct problems, hyperactivity and prosocial behaviour additionally supported partial strong measurement

invariance (factor loading and threshold invariance) over time. Measurement invariance testing therefore indicated that child age at assessment did not influence the operationalization of the measure.

Construct validity was assessed with tests of convergent and discriminant validity. Weak internal convergent validity suggested items may not be clear and distinct indicators of the behavioural constructs they are designed to reflect. The hyperactivity subscale provides the only exception; satisfactory internal convergent validity was demonstrated for this subscale despite having the least well performing modified preschool item in which only 15% of the variance in the item was explained by hyperactivity. Internal convergent validity was reported to be poorer among 5 to 7 year olds compared to 10 to 12 year olds (Niclasen, Skovgaard, Andersen, Sømhovd, & Obel, 2013). Thus child age may help explain this pattern of results. External convergent validity was supported with large positive correlations between corresponding factors measured at ages 3, 5 and 7 years. Preschool subscales also exhibited satisfactory discriminant validity which had not previously been addressed. Findings are inconsistent with school-aged studies in which subscales displayed poor discriminant validity, particularly between externalizing and prosocial factors (A. Goodman et al., 2010; Hill & Hughes, 2008).

Finally, the longitudinal design allowed examination of the predictive utility of the preschool SDQ. Correlations between preschool and age 5 scores were comparable to those between age 5 and 7 scores, supporting predictive convergent validity. Additionally, conduct problems and hyperactivity subscales demonstrated predictive criterion validity. Preschool hyperactivity scores identified 5 year olds at risk for poor personal, social and emotional development as rated by teachers, and clinical diagnosis of psychiatric disorders, specifically

Attention Deficit Hyperactivity Disorder (ADHD) and Autism Spectrum Disorder/Asperger Syndrome (ASD/AS) 2 years later. Preschool conduct problems positively predicted age 5 ADHD and ASD/AS. These findings are consistent with research using school-aged populations in which parent-reported SDQ scores predicted a range of developmental outcomes 3 years later including ADHD and ASD (Goodman et al., 2010).

In addition to assessing the psychometric properties of the preschool SDQ, this study also provides empirical support to the notion that psychiatric disorders can be identified in children as young as 3 years. While the SDQ is a screening, rather than diagnostic tool, it was important to verify it's clinical utility in this population. The early identification and treatment of psychiatric disorders is imperative, however identifying children at risk in a preschool population is hampered because of the rapid rate of socio-emotional and cognitive development during this period. The findings presented in Chapter 2 therefore indicate that it is possible to reliably distinguish between normative and maladjusted behaviours in preschool populations, and moreover to differentiate between different subtypes and domains of behaviours.

Having established the SDQ subscales as valid and reliable measures of child internalizing, externalizing and prosocial behaviours, the relationship between maternal depressed mood (MDM) and the difficulty subscales of the SDQ were examined across childhood. With the availability of the MCS age 11 observations this study extends previous findings by examining measurement invariance of the subscales over an 8 year period. Partial strong invariance (i.e. all factor loadings and only invariant thresholds) was demonstrated for all SDQ subscales. In addition, strong invariance was additionally reported across gender. Taken together, these findings indicate that the operationalization of child behaviour scales was not

influenced by child age or gender.

Chapter 3 reports evidence of a reciprocal, transactional relationship between MDM and all facets of problematic child behaviour. Mother and child represent mutual risk for increasing psychopathological symptoms across childhood. MDM and child behaviours predict increasing symptomatology for themselves, demonstrated through significant autocorrelations, and for one another, demonstrated through significant and positive cross-lagged effects. Thus reciprocity is the mechanism that drives this continuing risk across childhood. Significant bidirectional effects indicated that MDM predicted increases in child internalizing and externalizing behaviours measured at each assessment (parent effects), and likewise, all measured child behaviours predicted increases in MDM at each assessment (child effects). Bidirectional effects were significant and positive across childhood.

Several notable features were observed regarding the bidirectional effects. Estimates from age 3 to age 5 were equal in magnitude to those from age 5 to age 7 which is consistent with other studies that reported equality across time (Bagner, Pettit, Lewinsohn, Seeley, & Jaccard, 2013; Harvey & Metcalfe, 2012). We also reported that parent effects were of the same magnitude as child effects at each assessment. This finding is quite inconsistent with other bidirectional studies in which parent effects are typically reported as having a greater impact on the child, than child effects have on mothers (Elgar, Curtis, McGrath, Waschbusch, & Stewart, 2003; Nicholson, Deboeck, Farris, Boker, & Borkowski, 2011), however one other study reported equality of bidirectional effects across agent (Jaffee & Poulton, 2006). Finally, equality of estimates was demonstrated across gender indicating that boys and girls are affected equally by MDM, and likewise the effects of child emotional and behavioural problems are felt equally for mothers of sons and daughters. These findings are consistent

with previous literature (Bagner et al., 2013; Elgar et al., 2003).

Findings from this study indicate that reciprocity between maternal depression and child externalizing behaviours may be quantitatively different to reciprocity between MDM and internalizing problems of children. Bidirectional effects appear distinctly stronger between MDM and internalizing behaviours compared to externalizing behaviours. This suggests that emotional and peer problems have a stronger positive effect on MDM than conduct or hyperactivity problems; and likewise that MDM has a greater positive effect on the internalizing emotional and peer problems compared to internalizing conduct and hyperactivity problems. Evidence from previous research was equivocal; in one study the relationship was reportedly stronger between MDM and emotional problems compared to hyperactivity and conduct problems (Elgar et al., 2003) while in another MDM and externalizing problems were more strongly related (Nicholson et al., 2011). Although these two studies did not report statistical significance of differences, those presented here should be interpreted cautiously because SDQ subscales were modelled separately. However, because separate models used the same sample and observations at each age, the confidence intervals around the cross-lagged estimates that indicate bidirectional effects between MDM and internalizing were not overlapping with those representing MDM and hyperactivity suggest that they are significantly weaker.

The second research aim was to examine features of change in MDM and child emotional and behavioural problems across childhood. Scales were assessed both separately in univariate models, and then in unison in multivariate parallel process growth models to examine how MDM develops over time relative to conduct problems, hyperactivity, emotional problems and peer problems. Univariate models indicated a linear increase in

MDM symptoms from age 3 to age 11. Few studies have examined the trajectory of MDM over childhood, however our findings are contrary to one that reported a decline in symptoms over the first two years (Smith & Howard, 2008). Another study reported increases in MDM for the first 4 years, although this was not using latent growth modelling techniques (Woolhouse, Gartland, Mensah, & Brown, 2014). All child behaviours demonstrated non-linear declines over the same period which replicates findings from previous studies that have examined externalizing (Petersen, Bates, Dodge, Lansford, & Pettit, 2015) and internalizing (Keiley, Bates, Dodge, & Pettit, 2000) behaviours. Interestingly, in the latter study which examined both domains of child behaviour, internalizing behaviours showed relatively little linear change over time from initial levels (Keiley et al., 2000). This was also the case in our study, in which linear change was non-significant however a quadratic non-linear growth factor was significant. While Keiley and colleagues' study used a sample of 405, our much larger sample of almost 17,000 families may have provided adequate power to detect a quadratic growth factor to explain change in internalizing behaviours over time.

Correlating growth factors in latent growth models allows behaviours to be modelled together as parallel processes. Significant correlations between growth factors provide information about how the behaviours develop together, and highlight features of the relationship. Correlations between initial levels of MDM and each subtype of child behaviour were significant and positive indicating that increases in the symptoms of one member of the dyad were matched by increases in symptoms of the other member of the dyad. Change in the rate of externalizing behaviours over time was linked to initial levels of these behaviours, thus children with high initial levels of conduct and hyperactivity problems experienced the slowest decline over time in these behaviours. Additionally, initial levels of conduct and hyperactivity problems were negatively correlated with rate of change in MDM, thus

increases in MDM were more rapid for mothers of externalizing children. Taken together this suggests that children's externalizing behaviours may be more instrumental in maintaining maternal depressive symptoms, and equally, MDM may be more instrumental in maintaining externalizing problems.

Once again, the relationship between MDM and internalizing child behaviours appear quantitatively different. Contrary to the pattern of results reported for externalizing behaviours, initial levels and change over time were unrelated for internalizing difficulties, thus the rate of decline in internalizing problems is similar regardless of initial levels of problems. Similarly, internalizing problems were not significantly correlated with change in MDM, thus increases in depressive symptoms were unrelated to initial levels of emotional or peer problems. Thus distinct childhood trajectories for internalizing and externalizing behaviours were observed.

A final interesting correlation was observed between MDM and peer problems that has potential implications for child adjustment. A positive correlation was observed between initial levels of MDM and change in peer problems over time, such that children of depressed mothers experienced slower declines in peer problems across childhood. It is possible that disruptions to parenting caused by MDM impact child socialization make it more difficult for children of depressed mothers to successfully negotiate peer interactions or maintain peer relationships.

5.2 Theoretical, practical and clinical implications

An important overarching theme that has emerged through these three studies is a distinction between the internalizing and externalizing behaviours of children which is reflected in their

relationship with MDM. Important differences emerged between the internalizing subscales of the SDQ compared to the externalizing subscales in Chapter 2. In this preschool population, the externalizing behaviours appear to be more indicative of later problems. Both the externalizing disorders demonstrated predictive utility in accurately identifying preschool children at risk of psychiatric disorders (ADHD and ASD/AS) and poor personal, social and emotional development at age 5. Hyperactivity was the most prolific predictor identifying all three outcomes, while conduct disorder predicted ADHD and ASD/AS. In Chapter 3, within-time correlations between MDM and child behaviours were presented. In the externalizing ACL models, age 5 correlations between MDM and conduct and hyperactivity were not significant, suggesting that there is something particular about this age that eases the interdependency of mother and child behaviours. It is possible that attendance in formal school settings impacts this relationship. Previous research has reported transitions to school as an important time (Gross, Shaw, & Moilanen, 2008).

Results from parallel process growth modelling suggest a distinct relationship between the trajectories of MDM and externalizing problems compared to internalizing problems. Initial levels and rate of change in MDM and externalizing problems were significantly and positively correlated indicating that MDM symptoms increased more rapidly for depressed mothers of externalizing children, and rates of decline in problematic child behaviours were slower for externalizing children of depressed mothers. This seems contrary to the findings from Chapter 3 which indicated that MDM and externalizing problems had a weaker bidirectional relationship. This apparent misnomer can be explained by the different methodological approaches of both studies. In the reciprocal study, bidirectional associations (i.e. regressions) were indicated by the amount of variance in one behaviour at one time-point being explained by another variable at a previous time-point. Thus a significant amount of the

variance in age 5 hyperactivity can be explained by MDM at age 3. Overall we report that MDM and internalizing behaviours explain more variance in one another than MDM and externalizing problems. However, in the parallel process growth models, growth factors were correlated to establish how much change in one behaviour is influenced by growth factors for another variable. Thus declines in observed hyperactivity over time were correlated with high initial rates of MDM, while increases in MDM and decreases in internalizing problems were not correlated with initial rates of MDM.

Although emotional and peer problems did not distinguish preschool children at risk for later psychiatric problems, they exhibited a quantitatively different relationship with MDM, with distinctly stronger bidirectional associations with MDM across childhood. This finding was contrary to Goodman and colleagues' meta-analysis which reported that the relationship between MDM and internalizing problems was not significantly stronger than the relationship between MDM and externalizing difficulties (Goodman et al., 2011). However, this is likely to reflect methodological differences between the two studies. Research synthesized in the meta-analysis included both clinical and community samples of mothers (with community samples demonstrating smaller effect sizes), and included both clinical diagnostic measures of maternal depression alongside self-reported depression ratings (the latter demonstrating a smaller effect sizes). Additionally, the meta-analysis excluded data that controlled for associated variables, using only data that examined the direct parent and child effects of MDM and childhood psychopathology on one another, and using only the first data point in longitudinal studies. The data used in Chapter 3 however controlled for previous child behaviours, MDM and parent and child effects, therefore provides an accurate estimate of the magnitude of effects while controlling for previous behaviours.

Because internalizing behaviours demonstrated stronger bidirectional associations with MDM, this suggests that there may be important behavioural features in the preschool age group that both influence and are influenced by MDM. It is possible that it is more difficult for mothers to identify emotional problems in preschool children. Evidence from Chapter 4 which indicated that initial levels of internalizing problems are not significantly related to rate of change in MDM implies that mothers may be more aware of externalizing problems.

The current body of research has several clinical implications. Epidemiological studies aim to identify pathologies in the general population and examine features of the environment that influence the development of pathologies. These studies examine the internalizing and externalizing behaviours of children that represent emotional and behavioural disorders that may be present, though undiagnosed in the general populations. In an article that reviewed over 3 decades of epidemiological studies, Costello and colleagues propose that "children who make their way to clinical settings are likely to be different in many ways from the untreated cases that make up the majority of children with psychiatric disorders" (Costello, Erkanli, & Angold, 2006, p.1268). Although adolescent conduct and emotional problems have increased steadily over the last 25 years (Collishaw, Maughan, Goodman, & Pickles, 2004), evidence from a cross-cohort study of British preadolescents suggests that childhood EBDs of 7 year olds declined from 1999 to 2008 (Sellers, Maughan, Pickles, Thapar, & Collishaw, 2014). The alarmingly small number of children who receive appropriate clinical treatment for a psychiatric disorder have been documented in several studies (Bodden, Dirksen, & Bögels, 2008; Egger, Kondo, & Angold, 2006; Green, McGinty, Meltzer, Ford, & Goodman, 2005; Merikangas et al., 2010).

Numerous studies have sought to identify mechanisms in which negative parent-child

interactions become embroiled. Clinical research thrives on identifying ways to improve symptoms: "if we understood that ways in which new behavioral capacities become recruited in the 'service' of psychopathology, we might be better able to interrupt the progression of some disorders" (Angold & Egger, 2007, p.962). Increasingly, both child and parent factors have been identified as important in a reciprocal way. Such studies enhance our understanding of risk factors, correlates and mechanisms that perpetuate maladapted processes and help to identify children at greatest risk for psychopathology. These include measures of child-oriented factors such as individual differences in temperament, and parent-oriented factors such as parenting styles that reflect the mechanisms (e.g. withdrawal) by which depressed mood effects the emotional and behavioural development of children. Behaviours are reciprocal, continually emerging under the influence of internal and external factors. Factors, mechanisms or relationship features that are malleable have the potential to be targeted during clinical interventions. Because many parenting behaviours show this potential for change, they represent a critical focus for clinical research. However, growing awareness of the child's impact on the relationship is likely to redirect some focus to identifying malleable child factors.

Several clinical implications emerge from this set of studies. The first of these relate to the accurate detection of problematic behavioural constructs that predict later psychiatric disorders. While the validity of the school-aged SDQ has been confirmed, particularly in terms of predictive utility, the preschool validation that forms Chapter 2 supports the identification of problematic behaviours in preschool populations. More specifically, the preschool SDQ accurately identified subtypes of child behaviours across internalizing and externalizing domains. Childhood EBDs have comparable prevalence rates across the preschool and school-age developmental periods (Egger et al., 2006), thus identifying a

screening tool that detects specific problematic child behaviours is an important step in the early identification and treatment of disorders. Moreover, caregivers preferred using the brief 25-item SDQ compared to the longer 118-item CBCL (Goodman & Scott, 1999). Thus its application as a screening tool for use in preschool populations within the general population is encouraged.

Maternal depressed mood and childhood EBDs frequently co-occur, thus understanding how these distinct disorders disrupt normative family processes and negatively impact one another is crucial for successful treatment of either disorder. The role of parents and specifically mothers has been robustly associated with intergenerational transmission of psychopathy. Chapter 3 documents persistent, positive bidirectional effects in which MDM predicts later increases in conduct, hyperactivity, emotional and peer problems and similarly, each child behaviour predicts later increases in MDM. The relationship is reciprocal, interdependent and equally valenced across agent, gender and age. Together these findings have several clinical implications. Most notably, both parties appear to represent mutual risk for maintaining psychopathologies, therefore clinicians should identify if symptoms are being maintained in the context of a maladjusted parent-child relationship characterised by MDM and child EBDs. Additionally, interventions and treatments for one member of the dyad are likely to ameliorate symptoms for both (Shaw, Connell, Dishion, Wilson, & Gardner, 2009). Interventions aimed at treating both disorders simultaneously are likely to be most successful. Further, identifying reciprocity as a mechanism driving the maintenance of disorders offers a potential route for developing interventions aimed at reducing the impact of reciprocity on the dyad.

In the final study of Chapter 4, examination of the interdependent mother-child trajectories

provided informative perspective on developing psychopathologies. Important associations between MDM and externalizing behaviours were revealed with implications for treatment. The relationship between externalizing problems and MDM is complex and interwoven: significant positive correlations between initial levels of externalizing behaviours and MDM, and between initial levels and the rate of change in both disorders. Subsequently, these behaviours are most likely to perpetuate difficulties for one another. Conversely, while initial rates of MDM and internalizing problems were correlated, initial levels were not correlated with the rate of change in either disorder. This study also revealed that children of depressed mothers experience reductions in peer problems at a slower rate, with the implication that children of depressed mothers may require support and guidance with socialization processes.

Distinguishing the different associations between MDM and internalizing compared to externalizing behaviours also has clinical implications. Recognising that internalizing difficulties have a stronger bidirectional relationship with MDM is important in designing interventions to ameliorate or alleviate negative reciprocal processes that appear more enmeshed in internalizing behaviours. Changes in psychopathologies over time are more likely to occur within the context of MDM and externalizing behaviours. Because MDM and child internalizing behaviours do not influence change in one another over time, intervention and treatment efforts are more likely to be successful by focusing on the externalizing behaviours of children.

Finally, it is important to note that naturally occurring declines in antisocial behaviour which are not the result of clinical intervention or treatment have been reported. These declines have been described as unfolding within the context of daily family functioning. Because these changes are positive and don’t represent risk to the individual, their family, peers or the wider

society, they are not well understood in the literature. Buck and Dix (2014) propose the relationship between naturally declining rates and causal factors is likely to be asymmetrical, i.e. cessation in causal factors such as harsh or inconsistent discipline are unlikely to reduce problematic behaviour, causal relationships are likely to reflect more complex interactions between individual and environment to influence such change. Contextual changes that have occurred since the onset of ASB and the ongoing cognitive and socio-emotional development of the child are likely to influence desistence (Buck & Dix, 2014).

The current research has illuminated potential pathways to clinical intervention through both parent and child behaviours. The benefits of intervention efforts have been demonstrably greater in younger children who may experience a greater period of subsequent normative development, thus the preschool period has been identified as optimal for identifying and treating psychopathologies (Egger & Angold, 2006; Poulou, 2013). Evidence from in Chapter 2 confirms it is possible to identify children with emotional and behavioural problems in the preschool period and moreover to distinguish between symptoms in this age group. Reciprocal interactions between mother and child have been shown in Chapter 3 to perpetuate symptoms for both across this 8 year period of childhood. Previous research has demonstrated that disrupting this negative way of transacting can improve outcomes for both members of the dyad (Shaw, Connell, Dishion, Wilson, & Gardner, 2009). It is possible that reciprocal mechanisms may be employed to promote a healthier and more productive way of interacting between mother-child dyads. This offers a potential mechanism through which clinical intervention might be used to reduce negativity and promote positivity through positive, structured interactions. Finally, findings from Chapter 4 identify which behaviours are more likely to be successfully manipulated to provide more advantageous outcomes for the dyad. Reductions in child peer problems over time were reported to be significantly

correlated with initial levels of MDM symptoms, and increases in MDM symptoms were slower for mothers of externalizing children. This further supports the rationale for treating children at this early preschool stage.

It is possible to use the research findings in this series of studies to inform an intervention aimed at improving the relationship between mothers and their offspring. Children of depressed mothers experience reductions in peer problems at a slower rate and are therefore more likely to benefit from greater support and guidance with developing socialization skills. Previous research has identified that the socio-emotional development of children is an important mechanism through which MDM disrupts normative child development and is therefore a prominent factor in developing psychopathologies (Campbell et al., 2007; B. Oliver, Barker, Mandy, Skuse, & Maughan, 2011; Wu et al., 2011). Through interventions that for example by allowing both mother and child to working creatively together to produce something they can share and enjoy together, it may be possible to reduce parental and/or child withdrawal, and promote positive interactions which may lead to more positive reciprocity between the dyad.

5.3 Limitations and future directions

While these studies advance our understanding of the transactional relationship between mother and child psychopathology, some limitations of these studies should be noted. Mothers provide an important perspective on child behaviours and are an influential source of information in clinical decision making. This may be more valuable in terms of internalizing behaviours which teachers may not observe: “ many internalizing behaviors are relatively subtle and private, mothers may have more opportunity to observe situations in which these

behaviors occur" (Keiley et al., 2000, p.176). Mothers provided data on their own depressed mood as well as their child's behaviours for all studies. It is possible that use of a single reported can inflate associations between constructs, thus interpretation of results should reflect this potential for common method variance (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Replication of these findings using studies that employ multiple raters are likely to be beneficial.

A common concern in epidemiological studies that employ cohort datasets is that they are limited by the data that is available. Several features of MDM such as temporal proximity, chronicity and comorbidity have been associated with childhood psychiatric problems (Sellers et al., 2013). It was not possible to investigate these features of MDM using the MCS dataset. Similarly, the validation study presented in Chapter 2 was hampered by a lack of available criterion outcomes for internalizing disorders. It is possible that the preschool SDQ internalizing subscales might have detected children at risk of later internalizing disorders. It is plausible that these subscales would independently predict future internalising problems such as depressed mood and anxiety.

Finally, this series of studies excluded the influence of fathers on developing child EBDs. While the relationship between the father and child is likely to be highly important, particularly if those fathers have experienced depressed mood, however over 98% of respondents were mothers. This meant it was not possible to examine the father-child relationship in comparison to the mother-child relationship. Future studies that aim to examine the contribution of fathers to emerging child EBDs, or reciprocity between father depressed mood and child behaviours will undoubtedly illuminate developmental psychopathology further.

Many child factors are likely to influence developing psychopathologies and impact the relationship between MDM and childhood EBDs. Temperament represents a biologically based predisposition or diathesis towards emotional, behavioural and affective reactivity e.g. negative emotionality or surgency and self-regulatory processes such as effortful control (Rothbart & Bates, 2006). Such facets are the building blocks of emotional and behavioural regulation. Although underpinned by neurological functioning and therefore relatively stable, temperament is influenced by internal (socio-emotional and cognitive development) and external (environment) factors. It is this plasticity that is likely to explain how temperament relates differentially to emotional and behavioural difficulties in childhood. Temperament has been empirically linked to several impairments in socio-emotional development and has also been associated with MDM (Chen, Deater-Deckard, & Bell, 2014; Choe, Olson, & Sameroff, 2014; Else-Quest, Hyde, Goldsmith, & Van Hulle, 2006; Reck, Müller, Tietz, & Möhler, 2013). Identifying how features of infant temperament contribute to child behaviour problems and the relationship between MDM and child psychopathologies is likely to inform intervention and treatments.

While these studies identify significant differences in the relationship between MDM and internalizing compared to externalizing problems, further disentangling how maternal mood impacts the development and maintenance of child psychopathologies would be highly beneficial. Unpicking and identifying mechanisms unique to MDMs relationship with internalizing or externalizing problems has the potential to inform research, clinical treatments and intervention programs specific to mother-child dyads with coexisting psychopathologies.

5.4 Summary and conclusions

The rationale for these studies was to unpick and disentangle the relationship between MDM and childhood emotional and behavioural problems. First, the psychometric properties of the preschool SDQ were examined longitudinally. Its intended use as a screening tool to identify preschool children at risk for later clinical or developmental disorders was affirmed. Through the remaining two studies, interdependence between MDM and child internalizing and externalizing problems have been demonstrated. Across childhood, from age 3 to age 11, depressed mothers and children with EBDs represent mutual risk for maintaining psychopathological symptoms. MDM predicted increased internalizing and externalizing problems in children, and likewise children with EBDs exacerbated later MDM symptoms for mothers. This study indicated quantitative differences between the relationship of MDM and internalizing compared to MDM and externalizing; the latter appears to be a distinctly weaker reciprocal relationship than MDM and internalizing. Findings from the final study support this distinction. Initial levels of externalizing behaviours were significantly correlated with change in MDM over time, and initial levels of MDM were correlated with change in externalizing behaviours. Notably, MDM and internalizing behaviours were not associated with change over time in one another. Examination of mechanisms and trajectories has illuminated several potential targets for clinical intervention.

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Appendices

A. Strengths and Difficulties Questionnaire: School-age Version

B. Strengths and Difficulties Questionnaire: Preschool Version

C. Kessler 6 Maternal Depressed Mood Questionnaire

Appendix A: Strengths and Difficulties Questionnaire: School-age Version

Strengths and Difficulties Questionnaire

For each item, please mark the box for Not True, Somewhat True or Certainly True. It would help us if you answered all items as best you can even if you are not absolutely certain or the item seems daft! Please give your answers on the basis of the child's behaviour over the last six months or this school year.

Child's Name ..... Male/Female

Date of Birth.....

	Not True	Somewhat True	Certainly True
Considerate of other people's feelings	☐	☐	☐
Restless, overactive, cannot stay still for long	☐	☐	☐
Often complains of headaches, stomach-aches or sickness	☐	☐	☐
Shares readily with other children (treats, toys, pencils etc.)	☐	☐	☐
Often has temper tantrums or hot tempers	☐	☐	☐
Rather solitary, tends to play alone	☐	☐	☐
Generally obedient, usually does what adults request	☐	☐	☐
Many worries, often seems worried	☐	☐	☐
Helpful if someone is hurt, upset or feeling ill	☐	☐	☐
Constantly fidgeting or squirming	☐	☐	☐
Has at least one good friend	☐	☐	☐
Often fights with other children or bullies them	☐	☐	☐
Often unhappy, down-hearted or tearful	☐	☐	☐
Generally liked by other children	☐	☐	☐
Easily distracted, concentration wanders	☐	☐	☐
Nervous or clingy in new situations, easily loses confidence	☐	☐	☐
Kind to younger children	☐	☐	☐
Often lies or cheats	☐	☐	☐
Picked on or bullied by other children	☐	☐	☐
Often volunteers to help others (parents, teachers, other children)	☐	☐	☐
Thinks things out before acting	☐	☐	☐
Steals from home, school or elsewhere	☐	☐	☐
Gets on better with adults than with other children	☐	☐	☐
Many fears, easily scared	☐	☐	☐
Sees tasks through to the end, good attention span	☐	☐	☐

Signature ..... Date .....

Parent/Teacher/Other (please specify:)

Thank you very much for your help

Appendix B: Strengths and Difficulties Questionnaire: Preschool Version

Strengths and Difficulties Questionnaire

2-4

For each item, please mark the box for Not True, Somewhat True or Certainly True. It would help us if you answered all items as best you can even if you are not absolutely certain or the item seems daft! Please give your answers on the basis of the child's behaviour over the last six months or this school year.

Child's Name ..... Male/Female

Date of Birth.....

	Not True	Somewhat True	Certainly True
Considerate of other people's feelings	☐	☐	☐
Restless, overactive, cannot stay still for long	☐	☐	☐
Often complains of headaches, stomach-aches or sickness	☐	☐	☐
Shares readily with other children (treats, toys, pencils etc.)	☐	☐	☐
Often has temper tantrums or hot tempers	☐	☐	☐
Rather solitary, tends to play alone	☐	☐	☐
Generally obedient, usually does what adults request	☐	☐	☐
Many worries, often seems worried	☐	☐	☐
Helpful if someone is hurt, upset or feeling ill	☐	☐	☐
Constantly fidgeting or squirming	☐	☐	☐
Has at least one good friend	☐	☐	☐
Often fights with other children or bullies them	☐	☐	☐
Often unhappy, down-hearted or tearful	☐	☐	☐
Generally liked by other children	☐	☐	☐
Easily distracted, concentration wanders	☐	☐	☐
Nervous or clingy in new situations, easily loses confidence	☐	☐	☐
Kind to younger children	☐	☐	☐
Often argumentative with adults	☐	☐	☐
Picked on or bullied by other children	☐	☐	☐
Often volunteers to help others (parents, teachers, other children)	☐	☐	☐
Can stop and think things out before acting	☐	☐	☐
Can be spiteful to others	☐	☐	☐
Gets on better with adults than with other children	☐	☐	☐
Many fears, easily scared	☐	☐	☐
Sees tasks through to the end, good attention span	☐	☐	☐

Signature ..... Date .....

Parent/Playgroup leader/Nursery teacher/Other (please specify:)

Thank you very much for your help

Appendix C: Kessler 6 Maternal Depressed Mood Questionnaire

Binding margin – do not write

MENTAL HEALTH

K6+

Provider: _____

Provider ID:

Date completed: __ __ / __ __ / __ __ __ __

Please used gummed label if available

Patient or Client Identifier:

Surname:

Other names:

Date of Birth: Sex:

__ __ / __ __ / __ __ __ __ Male ☐1 Female ☐2

Address:

The following questions ask about how you have been feeling during the **past 30 days**. For each question, please circle the number that best describes how often you had this feeling.

Q1. During the past 30 days, about how often did you feel …	All of the time	Most of the time	Some of the time	A little of the time	None of the time
a. …nervous?	1	2	3	4	5
b. …hopeless?	1	2	3	4	5
c. …restless or fidgety?	1	2	3	4	5
d. …so depressed that nothing could cheer you up?	1	2	3	4	5
e. …that everything was an effort?	1	2	3	4	5
f. …worthless?	1	2	3	4	5

MENTAL HEALTH

K6+ SELF-REPORT MEASURE (1 of 2)

Please turn over the page to continue