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EFFORTFUL CONTROL AND THE IMPORTANCE OF PARENT-CHILD RECIPROCAL EFFECTS

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Summary of Research

This thesis examines the importance of parent-to-child and child-to-parent effects in the development of child effortful control. Although the influence of parenting on child effortful control development has been extensively researched, few studies have examined the effect of child effortful control on later parenting behaviours. By applying developmental cascade models to data from longitudinal studies, I have explored the relevance of the child’s rearing environment and early regulatory abilities on later developmental outcomes. The research examines how child effortful control may elicit the parenting behaviours that go on to further influence the development of child effortful control and other developmental outcomes, specifically child ADHD symptomology and maths performance. Two large longitudinal studies have been used to examine these parent-child effects; the first uses an adoption-at-birth design and the second uses a large UK general population sample, both of which have collected data over multiple time-points across development. This thesis includes the first study that tests for a direction of effects between hostile parenting and child ADHD symptoms in a design able to remove the confound of shared genes, highlighting the importance of parenting for child developmental outcomes. The second empirical chapter explores more closely the relationship between the components of effortful control and different parenting behaviours. This thesis also includes a systematic review of previous studies that have explored the impact of child effortful control on parenting behaviours, with thought given as to why some studies find a child-driven effect, and why some do not. The work included in this thesis explores, through both a thorough examination of the literature and empirical evidence, how different parenting behaviours may have different relationships with child effortful control. The impact of methodology choice
for study findings is extensively discussed. Overall, a bidirectional relationship between child effortful control and parenting behaviour was supported.
Statement

This thesis takes a ‘paper format’, so coauthors are listed as would be if submitting to a journal. Coauthors are supervisors who offered comments on drafts or part of the research team linked to the study (in the case of chapter 2). Chapter 1 was first drafted under the supervision of Professor Gordon Harold and Dr Ruth Sellers whilst part of the Rudd Centre research group. All chapters have been completed under the supervision of Professor Alison Pike and Professor Sam Cartwright-Hatton.

I hereby declare that this thesis has not been and will not be, submitted in whole or in part to another University for the award of any other degree.

Signature:...........................................

December 2019
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Chapter 1:

General Introduction

The healthy development of basic self-regulation in childhood is crucial for many later life outcomes. Parenting behaviours seem to play an important role in the development of child self-regulation development, but there is a dearth of research examining the role of early child self-regulation in predicting the parenting behaviours previously associated with child self-regulatory abilities. Thus, the current thesis aims to elucidate the roles of parenting behaviours and child self-regulatory abilities, specifically effortful control, in influencing one another. The research presented further aims to highlight the context in which these potential bi-directional parent-child effects may exist by exploring antecedents and consequences of these factors for child development.

This chapter aims to highlight the necessity of research exploring why some children develop self-regulatory problems, then details research into the role of parenting in the development of such problems and discusses the possibility of child-to-parent effects, before the importance of methodology choice is clarified in the context of exploring bi-directional effects. Finally, the following chapters of this thesis are summarised, with their relevance to the research questions of this thesis clearly noted.

The Role of Self-Regulation for Child Development

The term ‘self-regulation’ encapsulates any ability that enables an individual to regulate their own behavioural, cognitive, or emotional responses to situations encountered. The concept is broad and can include both complex processing (e.g. long-term planning) and basic, low-level processing (e.g. focusing attention); the term also
spans from bottom-up automatic processes (e.g. feeling hungry when need to eat) to top-down deliberate processes (e.g. inhibiting an unhelpful automatic response).

Similarly, executive functioning is described by Welsh, Pennington, and Groisser (1991) as goal-directed, future-oriented behaviour, and includes the ability to plan, undertake organised searches, adapt strategies to individual situations, and control impulses. Deficits in executive functioning, then, represent inadequate or lacking goal-directed behaviour and, therefore, could be evident through a tendency to act before thinking a situation through or an inability to apply and change problem-solving solutions appropriately to novel conditions. Various different executive functions have been investigated by researchers, but all represent cognitive-regulation in some form. These processes, although overlapping, differ from self-regulatory processes in that executive functions require deliberate, effortful responses, whereas self-regulatory abilities may be automatic bottom-up processes. Examples of components of executive functioning frequently examined by researchers include working memory, attentional control, inhibitory control, set-shifting, and planning (Blair & Razza, 2007; Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005).

The term ‘effortful control’ refers to the ability to focus on and complete a task efficiently, whilst being able to inhibit unhelpful behaviours that may hinder the completion of any goals (Liew, 2012; Zhou, Chen, & Main, 2012). Effortful control thus comprises two main components, namely ‘attentional control’, the ability to focus on an appropriate source of interest, and ‘inhibitory control’, the ability to withhold inappropriate or unhelpful behaviours, often in exchange for the production of socially acceptable behaviours. Although effortful control is considered a temperament trait (Zhou et al., 2012), with the concept capturing everyday self-regulation, the central components of effortful control, attentional control and inhibitory control, are
considered to be components of executive functioning. There is debate over whether effortful control could be considered trait-level basic executive functioning (e.g. Liew, 2012), as the defining features of effortful control are considered to be components of executive functioning themselves. Despite the overlapping constructs, different measurement approaches are typically taken by researchers depending on whether they aim to measure effortful control or attentional or inhibitory control as individual components of executive functioning. Whereas cognitive approaches, seeking to investigate executive functioning, have typically used laboratory tasks to assess attentional or inhibitory control, developmental approaches have typically employed questionnaire methods assessing temperament. As well as differences in methodology employed by researchers, the construct of effortful control specifically refers to earlier developing basic functions, whereas executive functioning can also include more complex processes (Nigg, 2017). Similarly, although there is overlap in definition between effortful control and self-regulation, as with executive functioning, effortful control refers to the deliberate control of behaviours or thoughts by the individual and does not cover bottom-up automatic processes. The overlap and distinction between the three concepts is shown in the Venn diagram presented in Figure 1.

Due to the overlap between these three constructs, pinpointing where the abilities of attentional control and inhibitory control fall within these categories comes with its challenges. Although these abilities are the key components of effortful control, some researchers choose to refer to these abilities as components of executive functioning (especially when measured using laboratory-based tasks and not temperament questionnaires), and equally some researchers refer to these abilities as important self-regulatory skills. Where effortful control, and its main components of attentional and inhibitory control, can arguably be defined as part of self-regulation or
executive functioning, the literature base exploring these important early-developing abilities is divided, with researchers using one approach often not utilising the knowledge base from other approaches (Zhou et al., 2012). Throughout the current thesis, the term ‘effortful control’ has been used when an attempt has been made to measure attentional and inhibitory control. The terms ‘executive functioning’ and ‘self-regulation’ are used when the research described does not explicitly examine effortful control (or attentional or inhibitory control individually), but instead measures aspects of these two constructs that do not fall within the definition of effortful control (again, see Figure 1). The reason for including research on these adjacent topics in any literature summaries, rather than solely focusing on research examining effortful control, is that due to the overlap between these constructs, similar mechanisms may be at play for the development of these abilities. Therefore, previous research on different components of executive functioning and self-regulation may help to inform our understanding of developmental pathways involving effortful control.

Figure 1. Venn Diagram of definitions of self-regulation, executive functioning, and effortful control.
Unsurprisingly given the overlap in definition, there are similarities between associated consequences of disruptions to the healthy development of executive functioning and effortful control. Executive functions largely develop within the first five years of a child’s life (Garon, Bryson, & Smith, 2008), and disruptions to the normal development of these functions can have long-lasting and sometimes severe implications (Miller, Nevado-Montenegro, & Hinshaw, 2012). For instance, several psychopathologies have been linked to poorer executive functioning, including attention-deficit hyperactivity disorder (ADHD), conduct disorder (CD), oppositional defiant disorder (ODD), autism spectrum disorders, obsessive-compulsive disorder (OCD), Tourette syndrome, and anxiety (Affrunti & Woodruff-Borden, 2015; Geurts, Verté, Oosterlaan, Roeyers, & Sergeant, 2004; Olley, Malhi, & Sachdev, 2007; Semrud-Clikeman, Walkowiak, Wilkinson, & Butcher, 2010; Sergeant, Geurts, & Oosterlaan, 2002; Willcutt et al., 2005). Poor executive functioning has been further linked to lower academic achievement (Biederman et al., 2004; Pearson et al., 2015; Thorell, 2007), with this effect particularly notable for maths (Bull & Scerif, 2001; Cragg & Gilmore, 2014). There’s even evidence that child executive functioning deficits mediate the relationship between parenting behaviours and child academic performance (Bindman, Pomerantz, & Roisman, 2015; Herbers et al., 2011). Herbers and colleagues (2011), for example, reported that for a sample of 4- to 7-year-olds the relationship between parenting quality and academic functioning was mediated by child executive functioning. It is possible, then, that executive functioning deficits act as the mechanism through which parenting behaviours influence child academic outcomes, with the environmentally-influenced child executive functioning abilities influencing performance at school.
Similarly, the first five years of development indicate an age when effortful control is developing at a fast rate (Hongwanishkul, Happaney, Lee, & Zelazo, 2005). By adolescence effortful control is relatively stable (Mun, Dishion, Tein, & Otten, 2018). Poorer effortful control is associated with greater psychopathology (Muris, van der Pennen, Sigmond, & Mayer, 2008; Sportel, Nauta, de Hullu, de Jong, & Hartman, 2011; Ursache & Raver, 2014), poorer academic performance (Allan & Lonigan, 2011), poorer social competence (Dennis, Brotman, Huang, & Gouley, 2007), poorer socioemotional functioning (Eisenberg, Liew, & Pidada, 2004), and prolonged antisocial behaviour (Veenstra, Lindenberg, Verhulst, & Ormel, 2009). Specifically, attentional control has been linked to performance at school (Kim, Nordling, Yoon, Boldt, & Kochanska, 2013), anxiety development (Armstrong, Zald, & Olatunji, 2011; Fox, 2010), and engagement in physical activities (Booth et al., 2013). Inhibitory control has been linked to maths performance (Gawrilow et al., 2014; Gilmore et al., 2013), work habits at school (Rimm-Kaufman, Curby, Grimm, Nathanson, & Brock, 2009), socioemotional functioning (Rhoades, Greenberg, & Domitrovich, 2009), theory of mind (Carlson & Moses, 2001), and risk for obesity (Anzman & Birch, 2009).

**Attention-Deficit Hyperactivity Disorder as a Regulatory Disorder**

Attention-Deficit Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder commonly diagnosed in childhood. The disorder is characterised by high levels of inattention, hyperactivity, and impulsivity. Individuals with the disorder fall into mainly inattentive, mainly hyperactive-impulsive, and combined type groups. Those with predominantly inattentive symptoms find it difficult to concentrate on one set task. Hyperactive-impulsive symptoms involve over-activity and impulsive behaviours, such as excessive fidgeting, an inability to stay still for a length of time, and a tendency to act on impulses immediately before considering consequences. DSM-5 (American
Psychiatric Association, 2013) notes that in preschool symptoms tend to be predominantly hyperactive, but that ADHD is usually diagnosed during primary school. Barkley (1997; 2000) further notes that symptoms are typically present by the time the child reaches 7-years of age. Prevalence rates for the disorder come to around 5% for epidemiology studies conducted across the world (Polanczyk, De Lima, Horta, Biederman, & Rohde, 2007).

Individuals diagnosed with ADHD have been found to have greater difficulties at school, struggling with both academic performance (Czamara et al., 2013; Hart et al., 2010; Kent et al., 2011) and behaviour in the classroom (LeFever, Villers, Morrow, & Vaughn III, 2002). Childhood ADHD symptoms have further been associated with long-term outcomes for adolescence and early adulthood, such as poorer social functioning (Bagwell, Molina, Pelham Jr, & Hoza, 2001), substance abuse (Lee, Humphreys, Flory, Liu, & Glass, 2011; Levy et al., 2014; Mannuzza, Klein, & Moulton, 2008) and increased risk of criminal behaviour (Fletcher & Wolfe, 2009; Mannuzza et al., 2008). Given the longevity of the effect of childhood ADHD symptoms on later life outcomes, it is important to understand the mechanisms that either lead to or maintain these symptoms.

Several systematic reviews and meta-analyses have explored the association between ADHD and various executive functioning deficits (e.g. Oosterlaan, Logan, & Sergeant, 1998; Pennington & Ozonoff, 1996; Sergeant et al., 2002; Willcutt et al., 2005). These reviews have shown that groups of children with ADHD display significantly worse executive functioning than control groups on a variety of tests. One particularly large meta-analysis by Willcutt and colleagues (Willcutt et al., 2005) concluded that this deficit could be found for both community and clinical populations, with 65% of group comparisons finding a significant difference. Effects were
particularly noticeable for tasks assessing response inhibition, planning behaviours, spatial working memory, and vigilance (defined as accuracy of response to the target stimulus).

Various components of executive functioning have been researched in relation to ADHD, including response inhibition, working memory, verbal fluency, planning, and set shifting/cognitive flexibility (Sergeant et al., 2002; Thorell & Wåhlstedt, 2006). Evidence demonstrates that children with ADHD perform significantly worse than controls on various executive functioning tasks (Oosterlaan, Logan, & Sergeant, 1998; Sergeant et al., 2002; Willcutt et al., 2005). For example, Biederman and colleagues (2004) compared groups of children aged between 6- and 17-years with and without ADHD on a variety of executive functioning tasks. Children with ADHD were almost three times more likely to be considered to have executive functioning deficits than the control subjects. The evidence from the literature base suggests that executive functioning is clearly associated with ADHD. In particular, research has drawn links between deficits in attentional and inhibitory control, or effortful control, and symptoms of ADHD (Nigg, Goldsmith, & Sachek, 2004).

Russell Barkley proposed a model of ADHD in which difficulties in self-regulation are regarded as a key element of the disorder (Barkley, 1997). Barkley argued that these cognitive deficits, caused by underlying abnormal brain functioning, are central to ADHD (Barkley, 1997; Barkley, 2000). Brown (2009) lent support to this theory of ADHD by noting that individuals diagnosed with ADHD show some form of disruption to their executive functioning in daily life. The idea of executive functioning deficits as a necessary component of ADHD is largely supported by the amount of literature detailing poorer scores on executive functioning tasks for children with ADHD compared with control groups. The idea of executive functioning deficits as
central to ADHD is further supported by the fact that several measures of childhood ADHD symptomology include items that encompass executive functioning. For example, the ‘Five to Fifteen’ (FTF; Kadesjö et al., 2004), a questionnaire designed to assess symptoms of ADHD and commonly comorbid disorders, explicitly includes a category of items looking at executive functioning. Other questionnaires such as the ‘Vanderbilt ADHD Parent Rating Scale’ (VADPRS; Wolraich et al., 2003) do not state that the questionnaire measures executive functioning, yet include items aiming to measure components of executive functioning, such as organisation, behavioural inhibition, and working memory. Deficits in executive functioning are clearly, then, seen by many researchers to be a fundamental part of ADHD.

Although children who perform particularly poorly on tests of executive functioning may be more likely to experience symptoms of ADHD, not all children with ADHD receive poor scores on these tests (Nigg, Willcutt, Doyle, & Sonuga-Barke, 2005; Willcutt et al., 2005). Willcutt and colleagues’ (2005) review found that 65% of studies had found a significant difference; this, however, implies that 35% of studies found no difference between ADHD and control groups. Similarly, in the previously noted study by Biederman and colleagues (Biederman et al., 2004), despite the rate of executive functioning deficits being higher for the ADHD group compared to the control group, two thirds of the ADHD group were reported as not having such deficits.

However, Brown (2009) argues that when studies conclude that not all individuals with ADHD have executive functioning deficits that this is due to studies typically examining only one specific component of executive functioning. As the exact profile of deficits may differ between children with symptoms of ADHD, when studies are only examining one particular component of executive functioning they are unlikely to find deficits for the total sample. Furthermore, despite Willcutt and colleagues’
(2005) meta-analysis covering several components of executive functioning, the sample in each individual study was only being assessed for specific difficulties. As Brown (2009) observes, if each individual with ADHD is individually assessed for all difficulties, then difficulties with self-regulation will become clear as core to the disorder. Indeed, effortful control and regulatory abilities have been identified as central temperamental traits in ADHD (American Psychiatric Association, 2013; Nigg, Goldsmith, & Sachek, 2004). Coming back to the diagnostic criteria for ADHD in DSM-5 (American Psychiatric Association, 2013), difficulties with attentional control and inhibitory control are considered to be at the heart of the disorder, with difficulties in at least one of these abilities required for diagnosis. Children with one subtype of ADHD may not present identical symptoms to children with a different subtype (i.e. inattentive vs. hyperactive-impulsive), but children diagnosed with the disorder by definition should have difficulties with either attentional or inhibitory control. Therefore, if studies examining both of these abilities find that some individuals with ADHD do not have difficulties in these areas, then the method of measurement is not accurately picking up on real-life difficulties.

Difficulties in attentional and/or inhibitory control (effortful control) seem to be intrinsically linked to ADHD. Early difficulties in effortful control may thus be seen as a risk marker for later ADHD symptoms, and understanding factors involved in effortful control development will allow researchers to reduce and prevent further challenges for children at risk for ADHD.

**Theoretical Approaches that Underpin Thesis**

**Developmental psychopathology.** Developmental psychopathology is the study of the aetiology of developmental outcomes, such as mental health problems or
wellbeing, developmental disorders, and educational outcomes. The field pulls together research from developmental psychology and clinical psychology (Cicchetti, 1984). Typically, developmental psychopathology research involves the testing of different pathways to the developmental outcome, referred to as the phenotype, that is being investigated; this allows for the elucidation of the roles of both nature and nurture in predicting the phenotype in question.

The importance of researching developmental pathways to child psychopathologies is clear given the long-term impact of childhood psychopathology; by understanding factors that mediate or moderate links between parent and child attributes, we can better understand how and when to provide interventions or prevention programmes that can promote family wellbeing outcomes. Research exploring the extent to which nature (genetic factors) and nurture (environmental factors) predict later life outcomes, and perhaps more importantly, how these factors influence later outcomes, can highlight the best approaches for intervention or prevention efforts. By implementing interventions or prevention programmes, not only could symptoms be reduced, but the long-term sequelae of these, such as those listed above, could be reduced.

**Gene-environment interplay.** Genes are likely to play a crucial role in the development of effortful control. Firstly, gene variants linked with the dopaminergic system have already been identified as being associated with effortful control (Rothbart & Posner, 2005). Secondly, evidence from behavioural genetics has shown that not only are parent and child self-regulation closely related (Bridgett, Burt, Edwards, & Deater-Deckard, 2015; Jester et al., 2009), but a substantial amount of this variance is likely to be explained by genetic influence (Plomin, DeFries, Knopik, & Neiderhiser, 2016).
However, genes are unlikely to predict effortful control on their own, and instead are likely to interact with environmental factors to predict outcomes (Lipscomb et al., 2014; Rutter, 2006). Although genes can increase the risk for developing poorer outcomes such as difficulties in self-regulation, the environment in which the child develops plays a hugely important role. Advantageous environments can act as a buffer against increased genetic risk, and equally poorer environments can exacerbate difficulties that genetic backgrounds provide. The diathesis-stress model posits that individuals with gene variants, or alleles, associated with poorer outcomes are more susceptible to adverse environmental influence than those without such risk alleles (Monroe & Simons, 1991). For those with these gene variants, a negative environmental influence could have a far more detrimental effect on the individual than for those without the risk allele. Children with greater genetic risk for poorer effortful control could be more vulnerable to the influence of maladaptive parenting behaviours or home environments.

However, researchers such as Jay Belsky have since suggested that individuals with these genes variants previously associated with poorer outcomes may also be more likely to flourish in enriching environments than those without these genes (Belsky, 1997; Belsky & Pluess, 2009). Previous research has suggested that genes may be associated with differential susceptibility, rather than risk per se (Belsky & Pluess, 2009). Certain gene variants, or alleles, have been associated with greater neurological plasticity, with individuals who possess these alleles being more susceptible to the effects of environmental influences (Belsky et al., 2009). It is possible, then, that children who inherit a greater number of plasticity alleles may be more influenced by both positive and negative environmental factors. In negative environments individuals with these particular gene variants may become especially prone to poorer outcomes,
just as the diathesis-stress model suggests, but in positive environments these individuals may actually thrive and produce better outcomes than individuals without these genetic backgrounds. Research exploring the concept of differential susceptibility for the development of self-regulation in adolescents has found that for those boys carrying a greater number of plasticity alleles, supportive and unsupportive parenting behaviours had a greater effect on self-regulation ability (Belsky & Beaver, 2011). Similar findings of the differential effects of structured parenting depending on genetic risk have been found for childhood behavioural problems (Leve et al., 2009). Future research should explore whether similar findings can be seen for child attentional or inhibitory control; it is possible that children who are considered at greater risk for poor effortful control may benefit more from positive parenting behaviours or family interventions.

Whether the diathesis-stress model or theory of differential susceptibility are more accurate portrayals of how genes and the environment interact to produce outcomes, both theories highlight the importance of the environment for those at greater genetic risk for poorer outcomes, such as self-regulation difficulties. These two theories suggest that children who are at greater genetic risk for poor effortful control might be a group who are more vulnerable to the influence of environmental factors associated with effortful control development.

Even when interaction effects are not observed, genetic risk and environmental risk often present simultaneously. For the vast majority of families, children are genetically related to their rearing parents, and thus links between parenting behaviours and child outcomes may not be entirely due to an environmental effect of the parenting behaviour on the child. The term ‘gene-environment correlation’ (rGE) refers to the notion that a child’s inherited genes may be playing a role in observed correlations
between an environmental factor and a specific child outcome (Knafo & Jaffee, 2013). For example, if a parent with poor effortful control passes genes associated with poor effortful control to their child, not only will their child be at greater genetic risk of developing poorer effortful control, but the parent is also likely to show parenting behaviours resulting from their own poorer effortful control. Thus, it is not possible to tease apart the extent to which any correlation between child effortful control and parent behaviour is due to an environmental parent-to-child effect or is due to shared genes between the dyad accounting for each of the expressed behaviours. This particular example is an illustration of passive rGE, where both genetic and environmental risk are being passed from the parent to the child, making it difficult to separate out the extent of the environment risk from the genetic risk. Another type of gene-environment correlation is evocative rGE, whereby a child’s genetically-informed traits may elicit particular responses from others in their environment, thus meaning that genes can play a role in predicting the environments that an individual is exposed to; therefore, environmental risk factors, such as parenting behaviours, may have partially genetically driven effects. Similarly, active rGE refers to the idea that children may choose their environments based on their genetic makeup; in other words, a child’s genetically-influenced temperament, abilities, or challenges may lead them to favour a particular environment that may even exaggerate these individual differences. For instance, a child who struggles with writing might not choose to engage in as many activities involving writing, and a child with an impulsive temperament might choose to associate with similar friends. Although active rGE might become more apparent later in development as freedom to select one’s own environment increases, both passive and evocative rGE can theoretically be seen across development, and thus should be kept in mind when
considering the relationship between child and parent attributes and the nature of child development.

**Influence of Parenting Behaviours on Child Effortful Control**

The role of parenting behaviours in shaping child development is well acknowledged (Kiff, Lengua, & Zalewski, 2011). Much evidence has been offered for the influence of positive parenting behaviours and parental attributes such as emotional warmth, parental support, and scaffolding behaviours on child developmental outcomes (e.g. Davidov & Grusec, 2006; Eisenberg, Cumberland, & Spinrad, 1998; Papp, Cummings, & Goeke-Morey, 2005). Cases of neglect offer an insight into the consequences of an absence of a nurturing home environment. For example, children raised in institutions that did not provide individual treatment or the chance to form an attachment with a loving caregiver figure have experienced poorer attentional control, lack of social competencies, and cognitive impairment (Kreppner et al., 2007; Sonuga-Barke et al., 2017). These examples are extreme cases, but even normal variations in parenting behaviours have been seen to have an effect on child developmental outcomes. For example, parental hostility has been associated with child internalising and externalising problems (Stocker, Richmond, Low, Alexander, & Elias, 2003). Overprotective parenting has been further associated with child anxiety (McLeod, Wood, & Weisz, 2007).

Specifically, research has identified several parenting behaviours associated with child self-regulation development. For example, higher emotional warmth from mothers at child age 2-years has been linked to better child self-regulation at 3-years (Eiden, Colder, Edwards, & Leonard, 2009). Maternal emotional warmth has also been shown to be associated with child inhibitory control on a snack delay task in 4- to 6-year-olds.
Parental sensitivity has been shown to have similar positive effects on child self-regulation (Fay-Stammbach, Hawes, & Meredith, 2014). Lucassen and colleagues (Lucassen et al., 2015) found that at child age 4-years, observed parental sensitivity was related to child inhibitory control. Both parental responsiveness (Merz, Landry, Montroy, & Williams, 2017; Pauli-Pott, Schloß, & Becker, 2018) and supportive parental behaviour (Schroeder & Kelley, 2010; Spinrad et al., 2007) have similarly been associated with child effortful or inhibitory control.

Whereas positive parenting has been associated with healthy self-regulation development, negative parenting behaviours have been found to delay development in this area. Evidence suggests that children whose parents show greater hostility, criticism, or anger towards them tend to have poorer effortful control (Hopkins, Lavigne, Gouze, LeBailly, & Bryant, 2013; Poehlmann et al., 2010). Harsh parental discipline has further been linked to poorer inhibitory or effortful control (Lucassen et al., 2015; Wang, Deng, & Du, 2018).

A great deal of evidence for the role of parental control has been detailed in the literature, with excess parental control being associated with poorer child self-regulation (Karreman, van Tuijl, van Aken, & Deković, 2006). Parental over-control, or negative control, in this thesis are terms used to describe parenting behaviours that enforce certain child behaviours and restrict opportunities for the child to make their own decisions or engage in problem-solving. One study exploring the association between parenting behaviours and child effortful control at 36-months-old revealed that fathers’ negative control, as measured during an observation task, was associated with poorer child effortful control, measured using a battery of laboratory tasks (Karreman, van Tuijl, van Aken, & Deković, 2008). Similarly, Roskam and colleagues (Roskam, Stievenart, Meunier, & Noël, 2014) found that in their longitudinal study, negative
parental control was associated with poorer child inhibitory control development between the ages of 2- and 8-years.

Scaffolding behaviours are parenting behaviours that encourage the child to think through problems and decisions themselves, are developmentally-appropriate, and are aimed at facilitating a shift from other-regulation to self-regulation for the child (Bibok, Carpendale, & Müller, 2009; Leith, Yuill, & Pike, 2018). Whereas parental overcontrol is associated with poorer child self-regulatory abilities, scaffolding behaviours have been shown to be linked to greater child effortful control (Bibok et al., 2009; Fay-Stammbach et al., 2014; Lengua, Honorado, & Bush, 2007). For instance, maternal autonomy support in infancy has been associated with later child executive functioning at age 3-years (Matte-Gagné & Bernier, 2011). Home environments that allow children to develop their own cognitive abilities, including maternal behaviours aimed at facilitating child cognitive development, have been previously associated with better child attentional control (Mezzacappa, Buckner, & Earls, 2011). Some researchers (e.g. Karreman et al., 2008) have even conceptualised scaffolding and over-controlling parenting to be two sides of parental control, with scaffolding behaviours equating to positive control by setting limits and promoting structure, and over-control or harsh discipline to represent negative control. However, in agreement with Grolnick and Pomerantz (2009), the current thesis will avoid use of the word ‘control’ when referring to scaffolding behaviours. I refer to this concept as ‘scaffolding’, rather than ‘positive control’, to avoid confusion with ‘negative control’, and because scaffolding involves the facilitation of the child’s own agency and problem-solving – a concept opposing the traditional image of ‘control’.

It is worth noting, when discussing parenting influences on child effortful control, that a parent’s own effortful control may influence their parenting behaviours
towards the child (Bridgett et al., 2015). Parents who struggle with regulating their own
behaviours or emotions may particularly struggle to hold back unhelpful responses to
challenging child behaviour. In particular, parents with poorer effortful control may
spend less time engaging in child-rearing activities (Bridgett et al., 2011) or may present
more negative parenting behaviours (Cuevas et al., 2014).

Is this Association Definitely a Parent-to-Child Link?

Although there is clearly an association between parenting behaviours and child
effortful control, it is possible that a straight-forward parent-to-child direction of effects
does not always account for such associations. Bell (1968) argued that correlational
studies only allow us to explore associations between parent and child factors, and not
to determine a direction of effects. This early paper debated whether child-to-parent
effects may sometimes be present when a parent-to-child direction of effects is
assumed. Similarly, Belsky (1984) proposed three major types of influence on parenting
behaviours, of which child characteristics was one. Belsky argued that difficult child
characteristics may elicit negative parenting behaviours that then in turn influence child
developmental outcomes. In the same vein, Patterson’s coercive family process model
describes a transactional process between parent and child, whereby the child reacts
negatively to a parental demand that is considered unjust, before the parent gives in to
the child’s demands, and ultimately the behaviours of both child and parent are
reinforced (Dishion, Patterson, & Griesler, 1994; Patterson, Dishion, & Bank, 1984).

Despite an early appreciation for the potential for child-to-parent evocative
(child driven) effects, most studies examining links between parenting and child
behaviours have still assumed a parent-to-child direction of effects without explicitly
testing for it, or often even without noting the possibility of a different direction of effects whilst discussing their own study limitations.

Much research that has examined the role of child characteristics in eliciting parenting behaviours has found support for child-to-parent effects (Avinun & Knafo, 2014; Pettit & Arsiwalla, 2008; Roskam & Meunier, 2012). Parenting behaviours have been found to be evoked from child characteristics such as conduct problems (Burke, Pardini, & Loeber, 2008; Pardini, Fite, & Burke, 2008), internalising and externalising problems (Serbin, Kingdon, Ruttle, & Stack, 2015), and symptoms of ADHD (Harold et al., 2013a). One study even found that when parents considered their children as displaying more challenging characteristics they were more likely to engage in corporeal punishment (Al Dosari, Ferwana, Abdulmajeed, Aldossari, & Al-Zahrani, 2017).

Evidence has been found for the role of child effortful control in eliciting specific parenting behaviours. For example, Hong and colleagues (Hong et al., 2015) found that poor child effortful control at 7-years predicted negative controlling behaviours from parents a year later. Poorer adolescent self-control may further have a bi-directional relationship with parental knowledge, with parents more likely to know more about what activities the adolescent engages in and with whom when the adolescent has poorer self-control (Yu, 2010). Poor effortful control at age 7-years has also been associated with stricter, authoritarian parenting at child age 11-years (Lee, Zhou, Eisenberg, & Wang, 2013). Healthy child effortful control development is further associated with more positive parenting behaviours, with child effortful control predicting later parental sensitivity (Blair, Raver, & Berry, 2014), parental responsiveness (Merz et al., 2017), and engagement in play with the child (Schoppe-Sullivan, Kotila, Jia, Lang, & Bower, 2013). Although evidence has been provided for a
child-to-parent effect of child effortful control on parenting behaviours from both cross-sectional and longitudinal studies, for the reasons noted above, the strongest evidence for a child-to-parent effect comes from studies employing cross-lagged designs explicitly testing for a direction of effects. For example, Eisenberg, Taylor, Widaman, and Spinrad (2015) found that preschool aged children’s poor effortful control predicted later observed intrusive parenting, even when controlling for previous parenting behaviours. Effortful control has additionally been shown to have a bidirectional relationship with harsh parental discipline (Baron & Malmberg, 2019; Cecil, Barker, Jaffee, & Viding, 2012). A child-to-parent direction of effects may be present in infancy for maternal comforting behaviours and child effortful control (Li, Pawan, & Stansbury, 2014). Furthermore, children’s effortful control may predict later parental teaching behaviours more than vice versa when measured in preschool (Eisenberg et al., 2010).

It is possible that sometimes positive child-to-parent effects are seen due to parents responding to a child’s particular needs. Research has shown that when children appear to struggle with a task, parents may get more involved (Leith, Yuill, & Pike, 2018; Robinson, Burns, & Davis, 2009). It is further possible that negative child-to-parent effects are seen as a result of increased parenting stress. Child effortful control has been shown to be a predictor of parenting stress (Paley, O’Connor, Frankel, & Marquardt, 2006), and parenting stress is associated with both negative parenting behaviours (Rodgers, 1993) and fewer parent-child interactions (Anthony et al., 2005; Farmer & Lee, 2011). Considering the evidence that child-to-parent effects on parenting behaviours can often be found, it is important to take child-driven effects into account when exploring the role of parenting behaviours on child development.
Importance of the Research Design Employed

As noted earlier, cross-sectional designs produce correlational data that only allows for an exploration of associations and does not allow for the testing of causal effects. In order to test for a direction of effects from one factor to another, a longitudinal design is required (Burkholder & Harlow, 2003). Furthermore, to fully test the direction of effects between child and parent behavioural styles, a cross-lagged design should be used (Abenavoli, Greenberg, & Bierman, 2015; Burkholder & Harlow, 2003). This design takes previous parent or child behaviour into account, allowing researchers to test whether parent or child factors have an impact on one another when the stability of each factor is taken into account. Although developmental psychopathology research relies on natural, non-experimental designs, these longitudinal methods bring us closer to establishing causal links than cross-sectional designs are able to. Study designs are needed that test for possible transactional processes between variables (Véronneau & Vitaro, 2007). Longitudinal designs also allow researchers to explore long-term effects of psychopathology in childhood (Ollendick & King, 1994).

Even with the use of longitudinal research designs, there is still a danger in inferring that associations between child and parent attributes constitute an environmental parent-to-child or child-to-parent effect in a traditional family design. When parents and children are biologically related in a sample it is not possible to unambiguously disentangle the influence of environmental and rearing influences from genetic influences. In other words, the relationship between parent behaviours and child outcomes may not be an environmental effect, but the associations may be due to genes shared by the dyad. For example, a parent who struggles to self-regulate their behaviours may appear more hostile and unable to hold back disciplinary actions, and if
their child also struggles to self-regulate it is difficult to establish whether this association is due to either the influence of hostile parenting or shared genes associated with difficulties in self-regulation. Genetically sensitive designs, such as those using samples of adoptive families, can allow us to better understand the nature of any parent-child links, and can establish whether parenting effects are truly present.

**Overview of Thesis**

Currently there is a limited research base utilising longitudinal study designs to test the importance of parent-child bidirectional effects for the development of self-regulatory problems. The current thesis sets out to explore the following research questions:

1) What influence does child effortful control have on parenting behaviours?
2) What is the role of parenting in the development of effortful control and ADHD symptomology?
3) How does poor child effortful control relate to later ADHD symptoms and consequent academic difficulties?

Based on previous evidence suggesting the presence of both parent-to-child and child-to-parent effects on self-regulation development, it was expected that both parent-to-child and child-to-parent effects would be seen for both child effortful control and child ADHD symptoms. It was further expected that child effortful control would predict later child ADHD symptoms, with a knock-on effect on difficulties with maths, due to evidence suggesting links between child effortful control and ADHD symptoms (e.g. Nigg et al., 2004) and between ADHD symptoms and maths ability (e.g. Czamara et al., 2013).
The work presented uses secondary data analysis, as this allowed the use of large longitudinal datasets that could facilitate developmental cascade models and cross-lagged and reciprocal effects models. Two longitudinal datasets were used: The Early Growth and Development Study (EGDS; Leve et al., 2007), an adoption-at-birth design; and The Avon Longitudinal Study of Parents and Children (ALSPAC) (Boyd et al., 2013; Fraser et al., 2013), a large general population study of families living in South-West England. This thesis further contains a systematic literature review of past research that has used longitudinal data to explore child-to-parent effects of child effortful control on parenting behaviours.

**Overview of empirical work.** First, a set of analyses using the adoption-at-birth EGDS dataset is presented. This chapter details the analyses testing the direction of effects between child trait impulsivity and child effortful control, and between child ADHD symptomology and parent-to-child hostility. These analyses informed a developmental cascade model. The cascade model tested the cascade of effects from birth mother ADHD symptoms to child effortful control and trait impulsivity, to parent-to-child hostility and child ADHD symptoms, to difficulties in maths performance.

Next, a systematic literature review is presented that explores the effect of child effortful control on parenting behaviours. The purpose of the review was to get a closer insight into possible effects of child effortful control on later parenting behaviours, after this relationship was observed in the first set of analyses. Reviewed papers used longitudinal designs to test for the presence of a child-to-parent effect in the sample. Factors associated with whether or not a child-to-parent effect was reported are discussed and compared.
Finally, the last empirical chapter details a set of analyses conducted using the general population ALSPAC dataset. This chapter explores the role of parenting behaviours for the development of the key components of effortful control (attentional and inhibitory control) and the subsequent effects of attentional and inhibitory control on parenting behaviours. By breaking down effortful control into these two main components, the chapter is able to identify whether these two abilities are associated with different parenting behaviours, allowing for debate into whether these abilities should be grouped together as standard. The chapter also explores the impact of controlling for covariates on model results.
Chapter 2:
The Role of Child Effortful Control and Mother-to-Child Hostility in the Development of Child ADHD Symptoms and Maths Performance: Utilising a Genetically Sensitive Research Design


Abstract

Attention-deficit/hyperactivity disorder (ADHD) is a commonly diagnosed disorder amongst children that is associated with several long-term consequences, including poorer maths performance. However, studies exploring the role of parent attributes in the development of such child outcomes rarely use samples that allow us to separate out genetic and environmental influences. The present study used a genetically sensitive sample to test a developmental cascade model of effects from birth mother ADHD symptoms to early child behavioural traits, to mother-to-child hostility and child ADHD symptoms, to maths performance. The study further examined the direction of effects between mother-to-child hostility and child ADHD symptoms. Results revealed a direction of effects from mother-to-child hostility to child ADHD symptoms, however effects of prior child effortful control on parent behaviours were also seen. The role of early child effortful control in the development of ADHD symptoms was highlighted. The importance of genes, rearing environments, and early child behavioural traits for child developmental outcomes are discussed in relation to the results.
The Role of Child Effortful Control and Mother-to-Child Hostility in the Development of Child ADHD Symptoms and Maths Performance: Utilising a Genetically Sensitive Research Design

Attention-deficit/hyperactivity disorder (ADHD) is a disorder characterized by high levels of inattention, hyperactivity and impulsivity. ADHD has a world-wide prevalence rate of around 5% (Polanczyk, De Lima, Horta, Biederman, & Rohde, 2007), and is one of the most frequently diagnosed disorders in childhood (Kaplan et al., 2004). Long-term adverse outcomes have been associated with ADHD in childhood, such as increased criminal behaviour (Mannuzza, Klein, & Moulton, 2008), a higher risk of substance abuse (Lee, Humphreys, Flory, Liu, & Glass, 2011), and reduced quality of life (Bussing, Mason, Bell, Porter, & Garvan, 2010).

Symptoms of ADHD may put children at a disadvantage for several academic outcomes, including lower performance on tests, a higher frequency of punishments, and a decreased likelihood of pursuing higher education (Daley & Birchwood, 2010; Loe & Feldman, 2007). Children with ADHD are also likely to receive poorer grades than children without such symptoms (Kent et al., 2011). Moreover, there is evidence that this impact of ADHD symptomology on academic performance may be more pronounced for maths than for reading ability (Lahey et al., 1998). Children with ADHD have been shown repeatedly to have difficulties with maths performance (Czamara et al., 2013; Hart et al., 2010), and this association may be explained by both genetic and environmental factors (Hart et al., 2010).

Academic aptitude and attainment are associated with several later life outcomes, such as income, occupation, and further education, with poor grades, or
leaving school without formal qualifications being associated with poor mental health, substance use, criminality, and aggression (Chen & Kaplan, 2003; Fergusson, Swain-Campbell, & Horwood, 2002). Maths ability is no exception, with early maths knowledge being associated with school achievement years later (Claessens & Engel, 2013). Early maths ability is particularly important considering the potential for children with low maths ability early in childhood to develop maths anxiety later (Maloney & Beilock, 2012), which may lead to the persistence of maths difficulties into later life (Ashcraft & Krause, 2007). Given the importance of academic ability for life outcomes and the previously established association between ADHD and difficulties with maths, further research into developmental pathways to ADHD symptoms and associated maths problems is warranted.

**Relationships Between Parenting Behaviours and Child ADHD Symptoms**

Research investigating the impact of parental behaviour and parent-child relationships on child ADHD symptoms suggests that conflicted parent-child relationships are common in families where a child has ADHD (Deault, 2010). Specifically, studies have shown that parenting attributes, such as rejection (Lifford, Harold, & Thapar, 2008), expressed emotion characterised by high hostility and emotional over-involvement (Peris & Hinshaw, 2003), and low involvement and inconsistent discipline (Ellis & Nigg, 2009), are associated with subsequent ADHD symptoms in children. One study specifically examining the role of parent-to-child hostility on the development of ADHD symptoms (Harold et al., 2013a) found that adoptive mother hostility towards the child predicted later child ADHD symptoms. However, the direction of effects between parent-to-child hostility and child ADHD symptoms may not necessarily flow from parenting behaviours to child symptoms.
Increasing evidence is establishing a bidirectional relationship between parenting behaviours and child behaviour problems (Lifford et al., 2008; Pettit & Arsiwalla, 2008). For example, Pardini, Fite, and Burke (2008) noted a bidirectional relationship between several aspects of parenting and child conduct problems. It is possible that parenting behaviours and child symptoms of ADHD may affect one another (Rogers, Wiener, Marton, & Tannock, 2009a; 2009b), which may, in turn, have further knock-on effects for child development outcomes.

Research has suggested that child ADHD symptoms may elicit parent-to-child hostility (Lifford, Harold, & Thapar, 2009). Lifford and colleagues (2009) utilised a longitudinal design to explore the direction of effects between parent-to-child hostility and child ADHD symptoms, with child symptoms predicting parent behaviours but not vice versa. Similar evocative effects have been found using an adoption-at-birth design, whereby early child impulsivity has been found to predict parent-to-child hostility (Harold et al., 2013a).

Parenting Behaviours and Academic Outcomes

Parent behaviours may further have an impact on academic outcomes for children. For instance, parental involvement (Fan & Chen, 2001; Jeynes, 2005), parental emotional unavailability (Sturge-Apple et al., 2006), and neglectful parenting (Glasgow, Dornbusch, Troyer, Steinberg, & Ritter, 1997) have all been associated with later school performance. Adolescent perceptions of parental authoritarianism have further been associated with poorer academic achievement, with findings shown across several cultures (Leung, Lau, & Lam, 1998). Given the association between authoritarian parenting and parent-to-child hostility (Zhou, Eisenberg, Wang, & Reiser, 2004), parent-to-child hostility may also be associated with child academic outcomes. Research
has supported this association, showing parent-to-child hostility to be negatively associated with child and adolescent academic performance (Melby & Conger, 1996). Similarly, research has shown parent-child conflict to be associated with academic ability (Eamon, 2005).

**Importance of Effortful Control and Impulsivity for ADHD and Maths**

Effortful control refers to the ability to direct attention towards a particular focus and to activate or withhold responses as appropriate for the situation (Liew, 2012). Effortful control can be defined as trait-level self-regulation (Nigg, 2017) that may be considered the temperamental form of executive functioning (Liew, 2012; Zhou et al., 2012). Effortful control encapsulates lower level components of executive functioning that tend to develop earlier than other components of executive functioning (Nigg, 2017). Effortful control (Nigg, Goldsmith, & Sachek, 2004) and its key components of attentional control (Martel & Nigg, 2006; Murray & Kochanska, 2002) and inhibitory control (Thorell & Wåhlstedt, 2006) have been shown to be associated with ADHD symptomology. Trait impulsivity, the tendency to respond quickly before thinking through outcomes, is also core to ADHD symptomology (Halperin, Matier, Bedi, Sharma, & Newcorn, 1992; White, 1999). DSM-5 notes that impulsivity is an essential criteria for both combined and hyperactive/impulsive subtypes of ADHD (American Psychiatric Association, 2013). It is likely that child ADHD symptoms are preceded by increased impulsivity and poorer effortful control earlier in childhood (Berlin, Bohlin, & Rydell, 2004; Harold et al., 2013a), and that these traits are influenced by genes passed on from parents (Harold et al., 2013a; Rothbart, Sheese, & Posner, 2007). It is possible that child temperament may act as a pathway through which parent traits have an influence on later child outcomes. For example, Ormel and colleagues (2005) found
that temperament traits at ages 10 to 11 years mediated the association between parent lifetime psychopathology and adolescent externalizing problems.

Effortful control may further play a role in the prediction of maths abilities. For example, Blair and Razza (2007) found that child effortful control at 5-years-old, particularly the component of inhibitory control, was associated with maths knowledge at age 6-years. Attentional control has further been associated with maths abilities in childhood (Preston, Heaton, McCann, Watson, & Selke, 2009). Similarly, Clark, Pritchard, and Woodward (2010) found that inhibitory control at age 4-years was associated with maths achievement at 6-years-old.

It is possible, given the reviewed evidence, that effortful control and trait impulsivity may be associated with both birth parent attributes and later child ADHD symptoms and subsequent maths difficulties. Currently, research has yet to examine a direction of effects between trait impulsivity and effortful control.

**Importance of Genetically Sensitive Designs**

Despite the clear importance of understanding the role of parenting in child development, and the further role of early child traits in evoking this behaviour, there lies a difficulty in examining the influence of parenting behaviours whilst genes are shared between the child and parent. In designs where the parents provide the child both genes and their rearing environment, it is not possible to completely disentangle genetic and environmental effects. This means that any significant effect that is attributed to the parenting behaviour may be accounted for by a gene-environment correlation (rGE), whereby associations between parent and child traits cannot be assumed to be either a result of genetic or environmental influence alone (Harold et al., 2013b). For studies where children are biologically related to their rearing parent, it is not possible to claim
with certainty that any proposed rearing effect is wholly an environmental influence, as shared genes between the child-parent dyad may account for both parent and child behaviour. Passive gene-environment correlation (rGE) refers to the concept that children reared by birth parents receive both their genes and their home environments from their parents, and so parents expressing a particular trait may pass on genetic vulnerability to the trait, but also the child’s rearing environment may be shaped by the parent’s trait (Jaffee & Price, 2012). Another effect that is difficult to determine with traditional family designs is evocative rGE. Evocative (or reactive) rGE is the concept that associations between child and parent traits may arise due to child genetically-informed attributes influencing parent qualities (Ge et al., 1996). An example of this relative to the current study’s theoretical model would be a child’s inherited impulsive temperament or poor effortful control providing greater stress for the rearing parents, and ultimately leading to an increase in hostile parenting towards the child.

Longitudinal adoption-at-birth designs allow for the examination of genetic and environmental influences and interplay between the two on child outcomes; such studies remove the confound of passive rGE and allow the examination of evocative rGE (Leve et al., 2007).

**Current Study Design**

The current analysis employs the Early Growth and Development Study (EGDS; Leve et al., 2007), a prospective adoption-at-birth design that uses a sample of children who were adopted into their rearing families within the first 3-months of life, with a mean placement of just 3 days.

The current study tests a developmental cascade model in order to examine the processes leading to the development of ADHD symptoms that may be associated with
difficulties at school, specifically maths performance. Developmental cascade models allow for the examination of processes across several stages of development in order to elucidate the pathways that may explain links between parent or early child attributes and later child outcomes (Obradović, Burt, & Masten, 2009; Wolchik, Tein, Sandler, & Kim, 2016). This design is better able to explore the processes through which early risk-factors may impact on later child outcomes, and can therefore suggest how and when interventions might best be implemented (Masten & Cicchetti, 2010; Obradović et al., 2009). Although testing each link individually can be helpful for informing such intervention efforts, by exploring several factors across different developmental stages it is possible to test whether each factor still remains a significant influence when other factors are taken into account. Furthermore, potential knock-on effects of early risk factors may be examined through the simultaneous testing of direct and indirect effects (Masten & Cicchetti, 2010). Specifically for this study, this design allows the examination of pathways that may precede academic difficulties that are commonly found for individuals with ADHD symptoms. By using a developmental cascade model, it is possible to explore longitudinal predictors of ADHD symptoms and maths performance, allowing for the testing of indirect effects from early child temperament traits and parenting behaviours on later child maths difficulties, via child ADHD symptoms. By testing these paths in the same model, a clearer picture of why children with ADHD so often experience greater challenges at school can emerge.

Harold and colleagues (2013a) previously used the EGDS sample to examine pathways to ADHD symptomology. The study established the impact of birth mother ADHD symptoms on child impulsivity, which evoked rearing mother hostility. Child trait impulsivity was found to significantly influence later child ADHD symptoms, both directly, and indirectly via adoptive mother hostility. The current paper further expands
on these findings by examining the impact of poorer child effortful control on the development of child ADHD symptoms, mother-to-child hostility, and child maths performance.

By testing a developmental cascade model it is possible here to examine the importance of both rearing and biological mother influences on child outcomes, as well as to examine whether early child attributes play a role in predicting either later child or parent behaviours. To further strengthen the final cascade model, cross-lagged and reciprocal effects models have been tested in order to establish a direction of effects for parts of the full model that were examined concurrently (specifically testing for direction of effects between child effortful control and trait impulsivity, and between child ADHD symptoms and parent-to-child hostility). By explicitly testing for a direction of effects between these factors, the full developmental cascade model can be informed further and present a more accurate picture of the order of processes relating to the child outcomes; this could provide a clearer idea of how and when to provide interventions. Currently there is limited evidence investigating the direction of effects between child ADHD symptoms and parent-to-child hostility using a design able to tease apart genetic and environmental familial risk. Although the direction of effects between child ADHD and parenting behaviours has previously been examined (Lifford et al., 2008; 2009), the current adoption-at-birth design provides the opportunity to control for passive gene-environment correlation when examining the environmental influence of rearing parents on child outcomes. Based on findings from previous research, it was hypothesized that a bi-directional relationship between child ADHD symptomatology and mother-to-child hostility would be found.

It was further hypothesised that a cascade of effects from birth mother ADHD symptoms to child ADHD symptoms at age 6 years via early child impulsivity and
poorer effortful control at age 4.5 years and adoptive mother-to-child hostility at 6 years would be seen. It was expected that increased child ADHD symptoms and greater mother-to-child hostility at age 6 years would be associated with poorer maths performance at age 7 years.

Method

Participants and Study Design

Participants were a sample of 361 linked sets of adopted children, adoptive parents, and biological mothers from Cohort I of the ‘Early Growth and Development Study’ (EGDS; Leve et al., 2007). EGDS is an ongoing longitudinal adoption-at-birth study that has tracked the development of children at frequent time-points throughout their infancy and childhood. The current analysis used data up to child age 7 years, and included all families, excluding same-sex adoptive parents, who had completed a minimum of one of the measures selected for the current analysis (n=344). Participants were recruited from 33 adoption agencies at multiple sites across the Northwest, Mid-Atlantic, and Southwest regions of the United States between 2003 and 2006. Eligibility criteria for the study included: (a) domestic adoption placement; (b) placement occurring within 3 months postpartum; (c) nonrelative placement; (d) no known major medical conditions; and (e) biological and adoptive parents able to understand English at eighth-grade level. Informed consent was provided by all families and data was collected via both home visit assessments and online questionnaires. Just over half of the children were male (57%), and the mean child age at adoption placement was 3 days. Participants included in the study were representative (based on level of education, family income, and parent age) of adoptive and birth parent populations presenting at the adoption agencies participating in the study at the time. Ethical
approval was awarded from the University of Oregon Institutional Review Board (protocol number: 04262013.036). Details about the sample and study design have been described in previous publications (Leve et al., 2007; Leve, Neiderhiser, Scaramella, & Reiss, 2010).

**Measures**

**Birth mother ADHD symptoms.** Symptoms were assessed using a combination of maternal reports for the attention control subscale of the Adult Temperament Questionnaire (ATQ; $\alpha = .73$) at child age 18 months (Rothbart, Ahadi, & Evans, 2000) and Barkley’s Adult ADHD scale ($\alpha = .90$) at child age 4.5 years (Murphy & Adler, 2004). The 5-item subscale of the ATQ asked mothers to report on levels of attention control on a 7-point rating scale ranging from ‘extremely untrue’ to ‘extremely true’. Barkley’s Adult ADHD scale assesses levels of impulsivity, hyperactivity, and inattention that have occurred throughout the 12 months previous. The 4-point scale ranged from ‘never’ to ‘very often’, with higher scores denoting greater symptoms of ADHD. The two scales were moderately correlated ($r = .48$) and so were standardized and then summed to create one variable of birth mother ADHD symptoms; the summed variable showed good internal consistency ($\alpha = .88$). Further details of this measure are provided elsewhere (Harold et al., 2013a).

**Child impulsivity.** Child trait impulsivity was assessed with adoptive mother reports of the Children’s Behavior Questionnaire (CBQ; Rothbart, Ahadi, Hershey, & Fisher, 2001) and the Behavioral Activation Scale (BAS; Blair, Peters, & Granger, 2004) at child age 4.5 and 6 years. The impulsivity scale of the CBQ includes 13 items of potential responses the child may have in certain scenarios, specifically relating to the typical speed of response initiation. Each question on the scale is rated out of seven
from ‘extremely untrue’ to ‘extremely true.’ Internal consistency estimates for the impulsivity scale were good ($\alpha = .78$). Mothers completed three subscales of the BAS (child drive, reward responsiveness, and fun seeking), that all included items on a 7-point scale scored from ‘extremely untrue’ to ‘extremely true.’ Internal consistency estimates for each subscale were good (drive $\alpha = .81$; reward responsiveness $\alpha = .70$; fun seeking $\alpha = .70$). The impulsivity subscale of the CBQ was correlated with each of the three BAS subscales ($r = .29$ to .66). The scales were therefore standardized and summed to form a single measure of child impulsivity/behavioural activation with good internal consistency ($\alpha = .87$). Details have been reported previously (Harold et al., 2013a).

**Child effortful control.** Child effortful control was assessed with adoptive mother reports on the Effortful Control factor of the Children’s Behavior Questionnaire (CBQ: Rothbart et al., 2001) at child age 4.5 and 6 years; this is a measure of everyday self-regulation that covers several abilities. The Effortful Control factor comprised four subscales of Attentional Focusing (focusing on appropriate task-related activities), Inhibitory Control (suppress inappropriate responses), Low Intensity Pleasure (pleasure gained from situations involving low intensity novelty), and Perceptual Sensitivity (ability to detect low intensity stimuli from the environment). The combined factor had good internal consistency ($\alpha = .86$).

**Adoptive mother-to-child hostility.** Mother-to-child hostility was assessed using self-reports by the adoptive mothers on the Iowa Family Interaction Rating Scales (Melby et al., 1993) at child age 6 and 7 years. The scale contains five items addressing hostile behaviours shown towards their child, with potential responses ranging from ‘never’ to ‘always’. Internal consistency estimates for mother reports of hostility were excellent ($\alpha = .91$).
**Child ADHD symptoms.** Symptoms were assessed using adoptive mother reports at child age 6 and 7 years on the Conner’s Abbreviated Parent Questionnaire. The scale contains 10 items reflecting hyperactive and inattentive behaviours (Conners, 1997), with higher scores indicating increased symptomology. Internal consistency estimates for the measure were good ($\alpha = .90$).

**Child maths performance.** Maths performance was assessed with the Woodcock-Johnson III achievement test at age 7 years (Woodcock, McGrew, & Mather, 2001). Z-scores were used to represent the normalized standard score for each child.

**Statistical Analysis**

First, correlations were tested between all variables to explore associations between these variables. Cross-lagged and reciprocal effects models were employed to explore the direction of effects between child impulsivity and child effortful control, and between mother-to-child hostility and child ADHD symptoms. Path analysis was then conducted examining the role of birth mother ADHD symptoms on adopted children’s impulsivity traits and effortful control, as well as the evocative effect of these early traits on later mother-to-child hostility. Associations between early childhood traits at age 4.5 years and later ADHD symptoms at 6 years were further examined, as were the influences of mother-to-child hostility and child ADHD symptoms at 6 years on later child maths performance at 7 years. Path analysis was conducted, and indirect effects explored, using MPlus, version 8 (Muthén & Muthén, 1998).

For the current study, 344 cases were available for analysis. A Full Information Maximum Likelihood (FIML) estimation method was applied, as this makes use of all available data. Model fit was assessed using the chi square, the Confirmatory Fit Index
(CFI), and the Root Mean Square Error of Approximation (RMSEA). Model fit is assumed to be good when the chi-square is non-significant, the CFI is at least .98, and the RMSEA is no greater than .05 (Kline, 2005). Due to issues of statistical power as a result of large numbers of families not completing all measures, the variables were imputed using Multiple Imputation by Chained Equations (MICE) with all available data. Multiple imputation was conducted in STATA version 13 (StataCorp, 2007). Twenty imputed datasets were created to account for missing data, and analyses were conducted using Mplus with the imputed datasets. Correlational analysis is presented using the raw data.

Results

Correlational/Preliminary Analyses

Table 1 contains pairwise correlations for the direction of effects analysis between child impulsivity and child effortful control. Child impulsivity at 4.5 years was positively correlated with child impulsivity at 6 years, and negatively correlated with child effortful control at 4.5 years and at 6 years. Child effortful control at 4.5 years was positively correlated with child effortful control at 6 years, and negatively correlated with impulsivity at 6 years. Child impulsivity and child effortful control at 6 years were negatively correlated.

Table 2 contains pairwise correlations for the direction of effects analysis between mother-to-child hostility and child ADHD symptoms. Mother-to-child hostility at 6 years was positively correlated with mother-to-child hostility at 7 years and with child ADHD symptoms at 6 years and 7 years. Child ADHD symptoms at 6 years were positively correlated with ADHD symptoms at 7 years and with mother-child hostility.
at 7 years. Mother-to-child hostility and child ADHD symptoms were positively correlated at 7 years.

Table 1

Correlations Between Impulsivity and Effortful Control at Both Time Points

<table>
<thead>
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<tbody>
<tr>
<td>1. Time 1 impulsivity</td>
<td>-</td>
<td></td>
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<td></td>
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<tr>
<td>2. Time 1 effortful control</td>
<td>-.29*</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Time 2 impulsivity</td>
<td>.75*</td>
<td>-.22*</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>4. Time 2 effortful control</td>
<td>-.24*</td>
<td>.77*</td>
<td>-.16*</td>
<td>-</td>
</tr>
</tbody>
</table>

*Note.* Time 1 was 4.5 years, Time 2 was 6 years.

*p < .01.

Table 2

Correlations Between Mother-to-child Hostility and Child ADHD Symptoms at Both Time Points

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>1. Time 1 Mother-to-child Hostility</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Time 1 Child ADHD</td>
<td>.31*</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Time 2 Mother-to-child Hostility</td>
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<td>.28*</td>
<td>-</td>
<td></td>
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<tr>
<td>4. Time 2 Child ADHD</td>
<td>.36*</td>
<td>.73*</td>
<td>.42*</td>
<td>-</td>
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*Note.* Time 1 was 6 years, Time 2 was 7 years.

*p < .01.
Table 3 contains pairwise correlations for the full model. Birth mother ADHD symptoms were correlated with child impulsivity, but not with child effortful control ($r = .01, p = .89$), mother-to-child hostility ($r = -.04, p = .56$), child ADHD ($r = .11, p = .13$), or maths performance ($r = .07, p = .33$). Early child impulsivity was correlated with child effortful control, and with child ADHD symptoms 18 months later, but not with mother-to-child hostility ($r = .13, p = .07$) or child maths performance ($r = -.05, p = .47$). Child effortful control was correlated with adoptive mother hostility, and with later child ADHD symptoms, but only approaching significance with child maths performance ($r = .12, p = .052$). Mother-to-child hostility was further correlated with child ADHD symptoms, but was not correlated with child maths performance ($r = .01, p = .84$). Finally, child ADHD symptoms were correlated with child maths performance scores.

Table 3

Correlations Between Variables for Full Model

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<td>1. Birth Mother ADHD</td>
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<td>2. Impulsivity</td>
<td>.18*</td>
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<tr>
<td>3. Effortful Control</td>
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<tr>
<td>4. Mother-to-child Hostility</td>
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<td>.13</td>
<td>-.23**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Child ADHD</td>
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<td>.44**</td>
<td>-.41**</td>
<td>.31**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Maths Performance</td>
<td>.07</td>
<td>-.05</td>
<td>.12</td>
<td>.01</td>
<td>-.15*</td>
<td></td>
</tr>
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</table>

*Note. Impulsivity and effortful control are measured at 4.5 years, and mother-to-child hostility and child ADHD are measured at 6 years.

*p < .05; **p < .01.
Path Analyses

**Direction of effects between impulsivity and effortful control.** The results from the cross-lagged model for effects between the child impulsivity and child effortful control measures at 4.5 and 6 years are shown in Figure 2 (panel a). Strong stability coefficients were seen for both child impulsivity and child effortful control (β = .74, p < .001; β = .76, p < .001, respectively) and these were not significantly different from one another. Child impulsivity and child effortful control were covaried at 4.5 years (β = -.27, p < .001), but not at 6 years (β = -.01, p = .89). No longitudinal cross-lagged effects were observed between child impulsivity at 4.5 years and child effortful control at 6 years (β = -.02, p = .62), or between child effortful control at 4.5 years and child impulsivity at 6 years (β = -.02, p = .597). Tests of reciprocal effects models (Figure 2, panel b) demonstrated no evidence of child impulsivity on child effortful control (β = -.01, p = .88), or vice versa (β = -.01, p = .83).

![Diagram of cross-lagged and reciprocal effects models](image)

**Figure 2.** Cross-lagged (panel a) and reciprocal effects (panel b) models for direction of effects between child impulsivity and effortful control.

*p < .01.*
**Direction of effects between mother-to-child hostility and child ADHD symptoms.** The results from the cross-lagged model for effects between the mother-to-child hostility and child ADHD measures at 6 and 7 years are shown in Figure 3 (panel a). Both measures were shown to be stable across time ($\beta = .65, p < .001$ for mother-to-child hostility; $\beta = .69, p < .001$ for child ADHD) and were not significantly different to one another. The measures were covaried at both time 1 ($\beta = .30, p < .001$) and time 2 ($\beta = .29, p < .001$). A direction of effects across the time-points was noted, with mother-to-child hostility at time 1 predicting child ADHD symptoms at time 2 ($\beta = .13, p = .001$), but not vice versa ($\beta = .07, p = .21$). A similar pattern of effects to the cross-lagged model was seen for the reciprocal effects model (see Figure 3, panel b), with mother-to-child hostility predicting child ADHD when measured at time 2 ($\beta = .19, p = .002$), but not vice versa ($\beta = .096, p = .14$).

*Figure 3. Cross-lagged (panel a) and reciprocal effects (panel b) models for direction of effects between mother-to-child hostility and child ADHD symptoms.*

*p < .01.*
**Full model.** The full model is presented in Figure 4. The findings from the direction of effects analyses informed the full model. The direction of effects from mother-to-child hostility to child ADHD symptoms was specified in the full model, but a non-directional correlation between early child impulsivity and child effortful control at 4.5 years was included, both relationships reflecting the results from these prior analyses. Fit indices indicated a good model fit ($x^2(5) = 5.78, p = .33; CFI = .99; RMSEA = .02$).

**Figure 4.** Theoretical model with results showing standardized coefficients.

* $p < .05$.

Birth mother ADHD symptoms predicted child impulsivity ($\beta = .16, p = .03$), but not child effortful control ($\beta = .04, p = .59$). Child impulsivity was associated with child effortful control at the same time-point ($\beta = -.28, p < .01$). Child effortful control ($\beta = -.20, p < .01$), but not child impulsivity ($\beta = .10, p = .19$), predicted later adoptive mother-to-child hostility. Both child impulsivity and child effortful control were associated with later child ADHD symptoms ($\beta = .29, p < .01; \beta = -.32, p < .01$, respectively). Adoptive mother-to-child hostility predicted child ADHD symptoms ($\beta =$
.19, p < .01), but only child ADHD (β = -.18, p = .01) and not mother-to-child hostility (β = .07, p = .26) predicted later child maths performance. Child effortful control at 4.5 years had an indirect effect on child maths performance at 7 years via child ADHD symptoms at 6 years (β = .06, p = .03). Finally, mother-to-child hostility at 6 years had an indirect effect on child maths performance at 7 years via child ADHD symptoms at 6 years (β = .03, p < .05).

**Discussion**

The present study aimed to build on the findings of Harold et al. (2013a) to explore the role of effortful control in genetic and environmental risk pathways to child ADHD symptoms and consequences for later maths performance. To explore such pathways to childhood outcomes we tested a developmental cascade model using a genetically sensitive, longitudinal research design. The genetically sensitive adoption-at-birth design allowed for the partitioning of birth and adoptive parent effects on child outcomes, which enabled the examination of parent-to-child and child-to-parent effects without the confound of shared genes. Overall, evidence for the cascade of effects from birth mother ADHD symptoms to child maths performance via early child temperament and child ADHD symptoms was found. Mother-to-child hostility was further seen to predict child ADHD symptoms.

**Direction of Effects**

Prior to conducting the full cascade model, cross-lagged and reciprocal effects models were used to determine appropriate directions of effects between variables examined concurrently for the cascade model. The direction of effects between child ADHD symptomology and mother-to-child hostility was examined between ages 6 and 7 years. In both cross-lagged and reciprocal effects models mother-to-child hostility
predicted child ADHD symptoms, but not vice versa. Previous research had suggested that child ADHD symptoms may predict later parent-to-child hostility (Lifford et al., 2009), however we are not aware of any previous study that directly tests the direction of effects between such constructs in a design able to separate out genetic and environmental risk. These findings indicate the importance of parenting behaviours for the development of child psychopathology, specifically ADHD symptoms. The findings from the current study differ to those found by Lifford and colleagues (2009), who found that child ADHD symptoms predicted parent-to-child hostility. One reason for the disparity of results may be that the previous study used a sample where the children were biologically related to their rearing parents. As explained earlier in the paper, when birth parents also provide the child’s environment, passive rGE cannot be eliminated, which means that it is not possible to know whether associations between parent behaviours and child traits are wholly environmental effects or if shared genes play a role. The current study is the first to examine this direction of effects in a design able to remove the confound of passive rGE, meaning that associations found between rearing parent and child attributes are not due to shared genes. Another consideration for the discrepancy in findings between the current study and the findings reported in Lifford et al. (2009) should be that this previous study explored the direction of effects at ages 11 to 14 years, much later in development than the current study. It has previously been suggested that the relationship between parenting and child psychopathology may differ in direction of effects when tested at different ages (Serbin et al., 2015). A different direction of effects may have been presented at an earlier stage of development in the current sample. Nevertheless, it is important that at the observed period of development examined in the current study, parent behaviour predicted later child ADHD symptoms.
Direction of effects analyses between child trait impulsivity and effortful control revealed that although there was a concurrent association between early child trait impulsivity and effortful control at age 4.5 years and stability was found over time for both traits, no direction of effects was found either longitudinally or concurrently at age 6 years. Previous literature has not tested a direction of effects between early child impulsivity and child effortful control, but it has been assumed that executive functioning deficits precede trait impulsivity (Bari & Robbins, 2013). It is possible that a lack of direction of effects may indicate that a causal relationship emerges prior to age 4.5 years, or that a common antecedent exists for these factors. As a response to these results the full model allowed the variables to covary, rather than imposing a direction of effects.

**Cascade Model**

The full model presented in the current paper suggests a cascade of processes from birth mother ADHD symptoms to child ADHD symptoms and finally maths ability, via associations with early child behavioural traits and mother-to-child hostility.

The importance of genes and the prenatal environment in informing early child behavioural traits that increase the likelihood of later child developmental outcomes has been established from the results of this developmental cascade model. Firstly, birth mother ADHD symptoms predicted early child impulsivity, and had a further indirect effect on child ADHD symptoms via early child impulsivity. The adoption-at-birth design of the current study ensures that any associations between birth parent and adopted child characteristics are attributable to genes or the prenatal environment, and not the child’s rearing environment. The indirect effect of birth mother ADHD symptoms on child ADHD symptoms found in this study supports findings of twin
studies that had previously highlighted the role of genetic risk for the development of ADHD symptoms (Thapar et al., 2013).

Both early child traits of increased impulsivity and poorer effortful control at 4.5 years were associated with increased child ADHD symptoms at 6 years. Research has previously established links between both trait impulsivity and effortful control and ADHD symptomology (Harold et al., 2013a; Martel & Nigg, 2006). Importantly, in the current study effortful control was associated with ADHD symptoms even when earlier impulsivity was accounted for. Effortful control at 4.5 years was further shown to be indirectly associated with maths performance at 7 years via these ADHD symptoms at 6 years. The importance of developing effortful control in early childhood is clear for later child outcomes, with the indirect effects of effortful control on maths outcomes found in the current study replicating past research findings of the importance of child effortful control and inhibitory control for child maths ability (Blair & Razza, 2007; Cragg & Gilmore, 2014). The importance of early child temperament, specifically impulsivity and effortful control, in predicting later child outcomes is highlighted in these results.

Despite the role of earlier child attributes on later child outcomes, the importance of maternal parenting behaviours was also clear in the model. It is of key importance that adoptive mother-to-child hostility was still associated with child ADHD symptoms when child effortful control and early impulsivity were accounted for, as the predictive value of both poor effortful control and increased impulsivity for later ADHD symptoms was found to be substantial in the current study. Previously this relationship between parental hostility and child ADHD symptoms had not been examined taking child effortful control into account (e.g., Harold et al., 2013a; Lifford et al., 2009). The finding that mother-to-child hostility is still an important predictor of child ADHD when earlier child impulsivity and effortful control are controlled for highlights the
importance of the family environment for the development of child ADHD symptomology. The indirect effect of mother-to-child hostility on child maths ability via child ADHD symptoms additionally highlights the importance of parenting for children at-risk for psychopathology such as ADHD. Although there was no direct association between hostile parenting and child maths performance, child ADHD symptoms linked these two factors. A cascade of effects from mother-to-child hostility to child ADHD symptoms to difficulties with maths performance at school can be seen for a proportion of the children in the sample. Further research is required to examine more closely the nature of the parent-to-child relationship and the influence that parenting behaviours and child effortful control have upon each other across development using a genetically sensitive and longitudinal study design.

As well as highlighting the importance of parenting behaviours for child developmental outcomes, the results of the model suggest that prior child attributes may predict later parenting behaviours. Although a wealth of research (see Fay-Stammbach et al., 2014, for a review) has examined the importance of parenting for child development outcomes, less research has examined the role that early child traits, such as poorer effortful control, play in predicting parenting behaviours. Previous analysis by Harold et al. (2013a) had revealed that early child impulsivity may evoke hostile parenting from the adoptive mother at 4.5 years. Although the current analysis did not replicate the same evocative effect of early child impulsivity on mother-to-child hostility longitudinally (i.e. no significant association between child impulsivity at 4.5 years and mother-to-child hostility at 6 years), the importance of child effortful control at 4.5 years on maternal behaviour at 6 years was highlighted. Previous research has noted the importance of parental hostility for the development of child executive functioning (Fay-Stammbach et al., 2014), yet the effect of poor child executive
functioning or effortful control on levels of parental hostility has not previously been examined. The current study was able to provide an insight into the impact of early child executive functioning, specifically effortful control, on parents’ hostile parenting behaviours. Clearly, more research into the nature of the relationship between early child effortful control and parenting traits is required to better inform intervention strategies targeted at improving child effortful control and associated psychopathology, such as ADHD symptoms. It is important to note that as the adoptive mother and child are not genetically related, the association between mother-to-child hostility and child ADHD symptoms found in the current study cannot be accounted for by shared genes, and instead represents an environmental influence in child developmental outcomes.

The finding that early child effortful control elicits mother-to-child hostility suggests that parent and child traits may have significant roles influencing each other, with a child’s early childhood traits evoking a particular parenting response that in turn may play a key role in the development of child ADHD symptoms.

As well as revealing possible pathways to the development of child ADHD symptoms, the model results further reveal the impact that ADHD symptoms can have on a child’s performance in school. Our findings highlight the significant impact that child ADHD symptoms can have on maths performance, supporting prior research that has established a link between child ADHD diagnosis and difficulties in academic settings (Loe & Feldman, 2007). It is important to note that children with symptoms of ADHD may have difficulties at school other than for maths, such as difficulties in reading (Czamara et al., 2013) and an increased number of sanctions (Daley & Birchwood, 2010). The link between ADHD symptoms and academic outcomes further emphasises the value of research aimed at understanding the factors and processes that are involved in the development of child ADHD symptoms.
Through the use of a developmental cascade model, the current study has revealed the role of both inherited attributes and rearing environment for the development of ADHD symptoms by age 6 years. Birth mother ADHD symptoms were found to impact child development via genetic or prenatal influences on early child temperament which then increased the likelihood of ADHD symptoms occurring later in childhood. The model has uncovered a cascade of effects from early risk factors to later academic difficulties that may be seen for children who develop ADHD symptomology. The importance of effortful control for later ADHD development and maths performance was especially highlighted in the current analysis. Child effortful control was shown to be important for later child ADHD symptoms, academic performance (as evidenced by the indirect effect of effortful control on maths performance via ADHD symptoms), and family relations (specifically, mother-to-child hostility). Although most interventions for executive functioning improvement are child-focused, interventions that seek to involve parents may prove beneficial. The established direction of effects between mother-to-child hostility and child ADHD symptoms further supports the assertion that parenting interventions may be helpful for families where a child is at-risk of developing ADHD symptoms. In support of this suggestion, parenting programs have previously been found to be effective for the improvement of child ADHD symptoms (Hoath & Sanders, 2002). The effect of child effortful control on mother-to-child hostility found in the current study suggests that such parenting interventions may benefit from including support in developing coping skills for dealing with challenging child behavioural traits. Such interventions may reduce the rate of intergenerational transmission of ADHD, and increase the likelihood of further positive outcomes, such as improvements in maths ability. Support has previously been provided for the long-term benefit of interventions for child executive functioning on later academic outcomes.
(Diamond & Lee, 2011). Providing support in parent coping techniques may further reduce parenting stress associated with poorer child executive functioning or effortful control (Paley, O’Connor, Frankel, & Marquardt, 2006).

**Limitations and Future Research Directions**

There are several limitations of the current study that should be noted. Firstly, only birth mother, and not birth father, ADHD symptoms were used to measure genetic risk. This inclusion of only birth mother data for the current analyses was due to the limited sample size of birth fathers completing these measures. It is possible that with the inclusion of birth father effortful control and ADHD symptoms a genetic component to child effortful control may have been established. Additionally, due to the majority of constructs in the current analyses being measured using mother reports, it is possible that shared rater bias may have impacted upon these results. For example, if a mother is feeling particularly agitated by her child, she may score herself relatively highly on the hostility measure whilst also rating the child as having more severe ADHD symptoms than if either she had answered the questionnaire at another time or if another informant had completed the questionnaire. Further research is thus required using combined mother and father reports to replicate these findings.

Secondly, the current analyses did not take either birth or adoptive parent maths ability into account, and it’s possible that parental maths ability may moderate the relationship between child ADHD or mother-to-child hostility and child maths ability considering the importance of parental influence for the development of child maths ability (Davis-Kean, 2005). Future research on developmental pathways to child maths ability may further take both birth and adoptive parent maths ability into account, as
parental maths ability may have a genetic and/or environmental influence on child maths outcomes.

A downside to using adoption studies is that adoptive parents tend to display greater positive parenting behaviours and fewer negative behaviours (Natsuaki et al., 2019; Stoolmiller, 1999) than parents in the general population, meaning that findings from such studies are not entirely generalisable. This is largely due to parents being selected for adoption on the basis of being able to provide a positive environment for the child (Castle, Beckett, Rutter, & Sonuga-Barke, 2010). This would suggest that for this sample mother-to-child hostility would be reduced and less varied between families than for a general population sample; caution should thus be taken when generalising the findings from this study. However, the evidence for the finding within the current study that adoptive mother-to-child hostility predicted child ADHD symptomology is particularly strong if, even when mother-to-child hostility is potentially less varied and lower than for the general population, parenting still had a significant effect on ADHD symptomology.

A limitation common to many longitudinal studies is that of missing data. However, the current analyses used MICE (Multiple Imputation by Chained Equations) to increase the power of the analyses performed in order to account for the missing data (which was missing completely at random).

Ideally the cross-lagged and reciprocal effects (direction of effects) analyses would have used outcome variables that mapped on to the same child age as looked at in the full model. However, the availability of measures at different waves in this study meant that these analyses were conducted using outcome variables that were later than those included in the full model. Instead, the direction of effects models explored the
direction of effects between ages 4.5 and 6 years for the analyses on associations between child impulsivity and effortful control, and at ages 6 to 7 years for analyses investigating the direction of effects between mother-to-child hostility and child ADHD symptoms.

It is important to note that adoption designs cannot fully disentangle the effects of the prenatal environment from genetic risk. It is possible that birth mother ADHD symptoms influenced the prenatal environment, thus leading to potential passive rGE. Only a design comparing families differing in both genetic relatedness and prenatal environment can offer a complete removal of passive rGE, namely, studies that compare families who have conceived using in vitro fertilization (IVF). However, initial evidence utilizing the IVF design supports the importance of the rearing environment for child developmental outcomes, with links between child and rearing mother ADHD symptoms and between mother-to-child hostility and child ADHD symptoms established (Harold et al., 2013a).

Future research should explore the importance of adoptive father hostility in pathways to child ADHD symptom development and maths outcomes. The importance of fathers’ parenting behaviours for child development has been established for several child development outcomes (Lamb, 2004), but has been under-researched compared to maternal parenting behaviours. Future research should address this gap in the literature and explore associations between father-to-child hostility and child ADHD symptomology.

Conclusions

Notwithstanding the noted caveats, the results of the current study provide evidence of a cascade of risk from birth mother symptoms, to early child behavioural
traits, to maladaptive parenting behaviours, to child ADHD symptoms, and finally to difficulties in maths. The importance of both genes and the rearing environment for child ADHD symptomology development has been highlighted. The finding that birth mother ADHD symptoms are directly associated with early child trait impulsivity and further indirectly associated with ADHD symptoms at a later stage in development reveals the impact of genetic risk on ADHD symptom development. The direction of effects found between mother-to-child hostility and child ADHD symptoms in this study further highlights the importance of parenting for child development, and suggests that parenting interventions may be helpful in reducing child psychopathology.

Although the importance of parenting behaviours for child development has long been a topic of interest, evidence from twin and blended family design studies had suggested that genes account for a greater proportion of variance in child outcomes (Neiderhiser, Reiss, Hetherington, & Plomin, 1999; Wright, Beaver, Delisi, & Vaughn, 2008). The genetically sensitive design employed by the current study has therefore evidenced that both inherited genes and home environments play a role in child development outcomes.

The current study adds to research suggesting that inherited child traits that emerge in early childhood may be associated with later child psychopathology, and helps to advance understanding of developmental pathways to academic outcomes. Importantly, the current study highlighted the significance of early child effortful control for later mother-to-child hostility. This suggests that parenting interventions focusing on child effortful control development and parental coping skills for parents of children at risk for poorer effortful control may be crucial. Child effortful control also predicted later ADHD symptoms, even when controlling for early child impulsivity.

The importance of effortful control for later child and family outcomes is clear, and
interventions may benefit several child outcomes if targeting early child effortful control, especially for children most at risk for developing ADHD.

The results of the current study provide a greater insight into links between parent and child attributes and the consequences that these have on later child development. The role of genes, early child behavioural traits, and parenting behaviours were all found to be important in the development of child outcomes. Specifically, child effortful control was found to play an important role in informing later mother-to-child hostility, child ADHD symptoms, and maths performance.
Chapter 3:

A Systematic Review on the Effect of Child Effortful Control on Parenting Behaviours

Simcock, V. E., Pike, A., & Cartwright-Hatton, S.

Abstract

Child effortful control is associated with several long-term developmental outcomes. Much evidence has been offered for the effects of parenting behaviours on the development of child effortful control. However, far less research has been conducted into possible child-to-parent evocative effects of child effortful control on parenting behaviours. Where most research into the associations between parenting behaviours and child effortful control uses cross-sectional data, longitudinal research is required to explore whether such parent-child associations can be partly attributed to child-to-parent effects. A systematic review of the literature was conducted to summarise evidence from longitudinal study designs that has tested the influence of child effortful control on parenting behaviours. Twenty-eight studies were identified as fitting the inclusion criteria for the review. Most of the included studies found some kind of child-to-parent effect, but effect sizes were typically quite low. Factors that may influence whether or not a study finds an effect were explored. Implications of the findings are discussed.
A Systematic Review on the Effect of Child Effortful Control on Parenting Behaviours

Effortful control is the ability to regulate behaviour as appropriate for a given situation, including focusing attention on one particular source of interest and being able to inhibit unhelpful behaviours whilst producing helpful ones (Liew, 2012; Zhou et al., 2012). Effortful control starts to develop during the first year of life and continues to improve across development (Kochanska, Murray, & Harlan, 2000; Nigg, 2017). Disruptions to the development of effortful control in childhood have been associated with difficulties in later social functioning (Eisenberg, Liew, & Pidada, 2004; Lengua, Honorado, & Bush, 2007), problem behaviours (Kim, Nordling, Yoon, Boldt, & Kochanska, 2013; Kochanska & Knaack, 2003), and psychopathological symptoms (Muris, van der Penne, Sigmond, & Mayer, 2008; Nigg, Goldsmith, & Sachek, 2004). Effortful control is positively associated with educational outcomes (Kim et al., 2013), in particular maths achievement (Brock, Rimm-Kaufman, Nathanson, & Grimm, 2009; Gilmore et al., 2013), and better work habits at school (Rimm-Kaufman, Curby, Grimm, Nathanson, & Brock, 2009). The importance of such self-regulatory abilities does not end at childhood, with evidence that high self-control is associated with better mental wellbeing, healthier interpersonal relationships, greater emotional regulation, and higher academic achievement amongst university students (Tangney, Baumeister, & Boone, 2004).

Poor child self-regulation has also been seen to predict parenting stress (Joyner, Silver, & Stavinoha, 2009; Paley, O'Connor, Frankel, & Marquardt, 2006) and even to predict parenting behaviours that are associated with later child developmental outcomes. For example, Brody and Ge (2001) found that child effortful control predicted harsh-conflicted parenting behaviours, which in turn predicted the child’s
psychological functioning a year later. Similarly, van der Voort and colleagues (van der Voort, Linting, Juffer, Bakermans-Kranenburg, & van Ijzendoorn, 2013) found that child effortful control in infancy predicted maternal sensitivity in adolescence, which in turn was associated with adolescent delinquency. Given the potential mediating role of parenting attributes for later child development outcomes, it is particularly important to identify when and how this developmental cascade of influences may occur.

**The Importance of Parenting for the Development of Child Effortful Control**

Previous research has identified parenting behaviours as being associated with child effortful control (Bridgett, Burt, & Edwards, 2015). Parenting behaviours such as scaffolding and the promotion of child autonomy (as opposed to over-control) in particular have been associated with the development of child effortful control (Fay-Stammbach et al., 2014). Although much research into the associations between parenting and child effortful control is cross-sectional, there are a number of longitudinal studies which do examine the nature of this relationship over time. For example, Kochanska, Murray, and Harlan (2000) found that mother’s responsiveness to the child when the child was 22-months-old predicted child effortful control at 33-months. Similarly, Spinrad and colleagues (Spinrad et al., 2007) found that the presence of mother supportive behaviour when the child was 18-months-old predicted child effortful control a year later. Again, in another study of 2- to 3-year-olds Lengua and colleagues (Lengua et al., 2007) revealed that limit setting and scaffolding behaviours shown by mothers were associated with child effortful control six months later.

**Potential for Child-to-Parent Effects**

A large number of studies have now demonstrated the importance of parenting behaviours for child effortful control development. However, such analyses rarely take
into account the impact of earlier child regulatory abilities on the parenting behaviours under scrutiny. It’s possible that, in such studies, a proportion of the variance assumed to be explained by a parent-to-child effect could be better explained by a child-to-parent effect. By simultaneously looking at the impact of parents and children on one another across time, more accurate estimates can be produced (Abenavoli, Greenberg, & Bierman, 2015; Burkholder & Harlow, 2003; Little, Preacher, Selig, & Card, 2007). This is not a new concept; Bell (1968) first proposed that cross-sectional, correlational studies of parent-to-child effects can’t show a direction of effects and that child-to-parent effects are likely to be present in such cases. Despite this early recognition that cross-sectional studies cannot accurately produce parent-to-child effect estimates, there are still relatively very few studies testing for a direction of effects between parent and child behaviours.

Previous research that has examined child-to-parent effects has established that early child attributes can play a part in predicting subsequent parenting behaviours (Pardini, Fite, & Burke, 2008; Pettit & Arsiwalla, 2008). For instance, Yan and Ansari (2016) noted a bidirectional relationship between child and parent functioning between kindergarten and third grade. Research has also shown that parents behave differently with offspring who struggle with self-regulation, when compared with those who do not (Al Dosari, Ferwana, Abdulmajeed, Aldossari, & Al-Zahrani, 2017; Yu, 2010). Specifically, child effortful control may predict parenting behaviours. For example, research has found that parents may respond more negatively to child behaviours associated with poorer effortful control than to child behaviours that are considered positive (Freeman, Johnston, & Barth, 1997). Additionally, children with greater effortful control may elicit more positive behaviour from their parents (Schoppe-Sullivan, Kotila, Jia, Lang, & Bower, 2013).
The Current Review

The current review aims to present research that has explored the impact of child effortful control on parenting behaviours. It will discuss a number of study characteristics that may have an impact on the likelihood of finding an effect. Previous research has suggested that bidirectional effects between parent and child attributes can change in direction of effect over time (Serbin et al., 2015), implying that significant child-to-parent effects may only be seen at certain child ages. There is also evidence from a previous meta-analysis on the effect of parenting behaviours on the development of child self-regulatory abilities that the relationship between these child and parent attributes may change depending on how parenting and self-regulation are operationalised (Karreman, van Tuijl, van Aken, & Deković, 2006). Finally, differences in results between studies are likely often a result of differing study designs (Nieminem, Lehtiniemi, Väähkangas, Huusko, & Rautio, 2013). This review will therefore examine differences in results according to the parenting behaviour that is being examined, the age of the child, and the study design that is being employed.

Method

A systematic review of the literature was conducted using five databases. PubMed (Medline), PsycInfo (Ovid), PsycArticles (Embase), Web of Science (Thomas Reuter), and Scopus (Elsevier) were each searched for titles, abstracts and keywords that were returned using the following search terms: (“effortful control” OR self-regulation OR “executive functioning” OR self-control) AND child* AND parent. Due to the large number of records returned by the search terms across the five databases (before duplicates deleted: n = 20891; after duplicates deleted: n = 10377), further search terms were applied within these results. The search terms applied for this second stage
included: bidirectional OR bi-directional OR cross-lagged OR evocative OR child-parent OR child-to-parent.

The inclusion/exclusion criteria for the review were: a) study must explore child effortful control; b) study must explore parenting behaviours (i.e. behaviours or behavioural styles relating specifically to the child); c) the study must examine the relationship longitudinally from child effortful control to parenting behaviours; d) animal studies were excluded; e) the study must be published in English (or already fully translated into English); f) the paper must detail an empirical study, so reviews, commentaries, and case studies were excluded; g) treatment studies were excluded; h) the paper must have been published in a peer-reviewed journal; i) access to the full-text article was available. The definition of effortful control used for the current review was the ability to inhibit unhelpful behaviours and/or ability to focus attention.

The number of original citations identified was 3705. Numbers of papers rejected and reasons why are presented in the flowchart in Figure 5. For clarity, the phrase ‘inappropriate measures’ in the flowchart refers to inclusion/exclusion criteria points a and b, and ‘inappropriate analysis’ refers to inclusion/exclusion criteria points c, f, and g. No papers were required to be rejected for detailing an animal study or not being published in a peer-reviewed journal. After screening titles and abstracts, and then assessing the full-text for appropriate citations, 28 papers were identified as fitting the review criteria.
To ensure reliability at both the screening stage (stage 1) and the selection stage (stage 2) a second coder was tasked with coding 10% \((n = 371)\) of titles and abstracts at stage 1 and a further 10% \((n = 20)\) of full texts at stage 2. Any discrepancies were discussed and agreements were made between the coders. At the screening stage (stage 1), inter-rater agreement reached 92%, but Cohen’s kappa was only 0.31; this was likely due to over-cautiousness, as all but one of the papers initially disagreed upon at this stage were subsequently rejected at stage 2. For stage 2 inter-rater agreement was 95%, and Cohen’s kappa was 0.83. Again, discrepancies were discussed and agreements were made between the coders.

**Results**

Study characteristics and results of the 28 studies that reached the inclusion criteria were extracted and are reported in Table 4. As can be seen in Table 4, the majority of studies (23/28) used a sample based in the USA. The studies differed as to whether a bidirectional relationship was tested for (19/28), or whether only child-to-parent effects were examined. The studies varied as to the methodology used to assess both child
effortful control and parenting behaviours, with some studies employing questionnaire designs, some observations or laboratory (lab) tasks and some using a mix of methods. Just over half of the studies (16/28) explored child effortful control prior to child age 5-years, with an equal number of studies exploring effortful control past this age (some studies explored effortful control both before and after age 5-years). Finally, the sample size of the studies varied greatly, ranging from 31 to 12,474 families.
### Study Characteristics

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<td>Data Collection</td>
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<tr>
<td>Kiel (2014)</td>
<td>USA</td>
<td>N=235</td>
<td>2.5Y - 3.5Y</td>
<td>Combined</td>
<td>Bidirectional</td>
<td>Maternal Sensitivity and Warmth</td>
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<tr>
<td>Spinrad et al. (2012)</td>
<td>USA</td>
<td>N=235</td>
<td>2.5Y - 4.5Y</td>
<td>Observation</td>
<td>Combined</td>
<td>Maternal Sensitivity and Warmth</td>
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<td></td>
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<td>Self-report</td>
<td>Maternal and Non-Caregiver Reported Questionnaires and a Laboratory Task</td>
<td>Socialisation (Supportive and Non-Supportive Responses)</td>
<td></td>
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<tr>
<td>Study</td>
<td>Country</td>
<td>N</td>
<td>Ages</td>
<td>Methodology</td>
<td>Data Source</td>
<td>Findings</td>
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<tr>
<td>Swanson, USA</td>
<td>USA</td>
<td>291</td>
<td>5Y → 6Y</td>
<td>Bidirectional</td>
<td>Parent-reported</td>
<td>Positive reactions to children's negative emotions</td>
<td></td>
</tr>
<tr>
<td>Taylor, USA</td>
<td>USA</td>
<td>210-</td>
<td>1.5Y → 2.5Y → 3.5Y → 5Y</td>
<td>Bidirectional</td>
<td>Parent and non-caregiver</td>
<td>Observation</td>
<td>Intrusive parenting</td>
</tr>
<tr>
<td>Eisenberg, Spinrad, &amp; Widaman (2013)</td>
<td></td>
<td>256</td>
<td></td>
<td></td>
<td>Observation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tiberio et al., USA</td>
<td>USA</td>
<td>147-</td>
<td>3Y → 5Y → 7Y</td>
<td>Bidirectional</td>
<td>Mother and father reported</td>
<td>Self- and partner-reported</td>
<td>Poor discipline and positive parenting</td>
</tr>
</tbody>
</table>
11Y → questionnaires at questionnaires (poor
13Y 3Y and 5Y, and discipline).
then mother, Self-report
father, and child questionnaire and
reported observation (positive
questionnaires parenting).
from 7Y
onwards

van der Holland N=145-
Voort, (internationally 160 Infancy (IY, 1.5Y,
Linting, adopted 2.5Y) →
Juffer, children) 7Y → 14Y

Bakermans-
Kranenburg,

& van
Overall, 17 out of the 28 studies included in the review (61%) found at least some support for child effortful control predicting later parenting behaviours. However, for 14 of these studies this effect was conditional on factors such as the age of the child or the particular parenting behaviour examined. As expected, studies with smaller sample sizes required larger effect sizes for child-to-parent effects to reach traditional significance thresholds. Most of the studies (68%) that examined bidirectional effects found a parent-to-child effect. Table 5 displays the full results.

The studies were then compared based on: age of the child; the specific parenting behaviour or style examined by the study; and study design (namely, methodology used and whether or not the study examined bidirectional parent-child effects).

Table 5.

*Study results table.*

<table>
<thead>
<tr>
<th>Study</th>
<th>Evidence of child-to-parent effect?</th>
<th>Effect size (β) for child-to-parent effect</th>
<th>Controlled for</th>
</tr>
</thead>
</table>
Teaching behaviours (child inhibitory control):
\( \beta = .04, p = .54. \)

Parental involvement (child task orientation):
\( \beta = .11, p = .17. \)

Teaching behaviours (child task orientation):
\( \beta = .05, p = .45. \)

Barnes, Boutwell, Beaver, & Gibson (2013) Y – conditional Model including parent-rated child externalising behaviours: \( \beta = .11, p < .05. \) Ethnicity, child sex, and concurrent child externalising behaviour.

Model including care-provider-rated externalising behaviours: \( \beta = .13, p < .10. \)

Baron & Malmberg (2019) Y – conditional 3 years to 5 years: \( \beta = -.05, p < .001. \) Earlier harsh parenting (and concurrent child self-regulation), child sex, child age, mother’s psychological distress, maternal education, advantaged/disadvantaged (inc. ethnic minorities), low family SES.

5 years to 7 years: \( \beta = -.01, p > .05. \)
<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Year</th>
<th>Sample</th>
<th>Statistic</th>
<th>Effect Size</th>
<th>Related Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brody &amp; Ge (2001)</td>
<td>Y – conditional</td>
<td>Harsh-conflicted parenting: $\beta = -.25, p &lt; .05$. Nurturant-responsive parenting: $\beta = .16, p &gt; .05$.</td>
<td>Earlier parenting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cecil, Barker, Jaffee, &amp; Viding (2012)</td>
<td>Y</td>
<td>Child ages 3 to 4 years: $\beta = -.07, p &lt; .01$. Child ages 4 to 7 years: $\beta = -.11, p &lt; .001$. Child ages 7 to 9 years: $\beta = -.07, p &lt; .05$.</td>
<td>Earlier parenting (and concurrent self-control), and non-independence of twin scores (twins rating similarly to one another).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eisenberg, Taylor, Widaman, &amp; Spinrad (2015)</td>
<td>Y</td>
<td>Child age 2.5 years to 3.5 years: $\beta = -.20, p &lt; .05$. Child age 3.5 years to 4.5 years: $\beta = -.32, p &lt; .05$.</td>
<td>Earlier parenting (and concurrent child effortful control), child sex, household income, and maternal education.</td>
<td></td>
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</tr>
<tr>
<td>Eisenberg et al. (2005)</td>
<td>N</td>
<td>Not significant, no effect size provided.</td>
<td>Earlier parenting (and concurrent child effortful control). Child age explored as potential moderator.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Eisenberg et al. (1999)  
Y – conditional  
7 years to 9 years (model with mother-reported behavioural problems): $\beta = -0.28^*, p < .05$.
7 years to 9 years (model with father-reported behavioural problems): $\beta = -0.33^*, p < .05$.
9 years to 11 years (model with mother-reported behavioural problems): $\beta = -0.06^*, p > .10$.
9 years to 11 years (model with father-reported behavioural problems): $\beta = -0.06^*, p > .10$.

Eisenberg et al. (2008)  
N  
Not significant, no effect size provided.

Eisenberg et al. (2010)  
Y – conditional  
Cognitive assistance from 1.5 years to 2.5 years: $\beta = 0.58, p < .01$.
Cognitive assistance from 2.5 years to 3.5 years: $\beta =$ Previous cognitive assistance, concurrent child effortful control, child sex, child age. SES was a covariate of Earlier parental punitive responses and child problem behaviour (for the model with mother-reported behaviour).
.26, $p < .05.$

Maternal questioning at T3.

Directive teaching strategies from 1.5 years to 2.5 years: $\beta = -.42, p < .01.$

Directive teaching strategies from 2.5 years to 3.5 years: $\beta = -.19, p < .05.$

Maternal questioning from 1.5 years to 2.5 years: $\beta = .36, p < .01.$

Maternal questioning from 2.5 years to 3.5 years: $\beta = -.07, p > .05.$

<table>
<thead>
<tr>
<th>Study</th>
<th>N</th>
<th>Regression</th>
<th>Effect Size</th>
<th>Predictor/Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Garbcz, McIntyre, &amp; Santiago (2016)</td>
<td>N</td>
<td>Wasn’t included in final model as wasn’t a significant predictor (multiple regression model building).</td>
<td>Child ASD symptoms, satisfaction with accessing services during childhood, child adaptive behaviour.</td>
<td>No effect size provided.</td>
</tr>
<tr>
<td>Heatly &amp; Votruba-Drzal (2017)</td>
<td>Y</td>
<td>$\beta = .16, p &lt; .001.$</td>
<td>Child cognitive skills (at 36 months), child gender, child race, number of children in household, maternal employment status, maternal marital status, maternal education,</td>
<td></td>
</tr>
<tr>
<td>Study</td>
<td>Sample Size</td>
<td>Parental Change</td>
<td>Additional Information</td>
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<tr>
<td>Hong et al. (2015)</td>
<td>Y – conditional</td>
<td>Change (increase) in parental negative control: $\beta = -0.13$, $p &lt; 0.01$.</td>
<td>No reported covariates</td>
<td></td>
</tr>
<tr>
<td>Klein et al. (2018)</td>
<td>N</td>
<td>Not significant, no effect size provided.</td>
<td>Cognitive ability</td>
<td></td>
</tr>
<tr>
<td>Kochanska, Friesenborg, Lange, &amp; Martel (2004)</td>
<td>N</td>
<td>$\beta = 0.03$, $p &gt; 0.05$.</td>
<td>Child gender, child joy, child anger, child fear, and mother interpersonal traits (mistrust, manipulation, aggression, dependency, entitlement, and workaholism).</td>
<td></td>
</tr>
<tr>
<td>Lee, Zhou, Eisenberg, &amp; Wang (2013)</td>
<td>Y – conditional</td>
<td>Authoritarian parenting: $\beta = -0.18$, $p &lt; 0.05$.</td>
<td>Earlier authoritative and authoritarian parenting, demographics</td>
<td></td>
</tr>
<tr>
<td>Lengua (2006)</td>
<td>Y – conditional</td>
<td>Change (decrease) in rejection behaviour: $\beta = -0.38$, $p &lt; 0.01$. Change in inconsistent discipline: $\beta = -0.12$, $p &gt; 0.05$.</td>
<td>Family income and initial parenting demographics</td>
<td></td>
</tr>
</tbody>
</table>

household income.
<table>
<thead>
<tr>
<th>Study</th>
<th>Y or conditional</th>
<th>Effect on EF Tasks</th>
<th>Parameters Adjusted</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lengua &amp; Kovacs (2005)</td>
<td></td>
<td></td>
<td>Parental acceptance: $\beta = .09$, $p &gt; .05$</td>
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<td></td>
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<td>Parental involvement: $\beta = -.08$, $p &gt; .05$</td>
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<td></td>
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<td>Inconsistent parenting: $\beta = -.02$, $p &gt; .05$</td>
<td></td>
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<tr>
<td>Merz, Landry, Montroy, &amp;</td>
<td></td>
<td></td>
<td>Delay inhibition tasks: $\beta = .13$, $p &lt; .05$</td>
<td></td>
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<tr>
<td>Williams (2017)</td>
<td></td>
<td></td>
<td>Conflict EF tasks: $\beta = -.07$, $p &gt; .05$</td>
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<tr>
<td>Padilla-Walker &amp; Coyne (2011)</td>
<td></td>
<td></td>
<td>Maternal prearming: $\beta = -.10$, $p &gt; .05$</td>
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<td></td>
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<td></td>
<td>Paternal prearming: $\beta = -.16$, $p &lt; .05$</td>
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<td></td>
<td></td>
<td></td>
<td>Maternal cocooning: $\beta = -.24$, $p &lt; .01$</td>
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<td></td>
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<td></td>
<td>Paternal cocooning: $\beta = -.23$, $p &lt; .01$</td>
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<td></td>
<td></td>
<td></td>
<td>Maternal deference: $\beta = .19$, $p &lt; .01$</td>
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<tr>
<td>Padilla-Walker, Coyne, Fraser,</td>
<td></td>
<td></td>
<td>Can’t calculate standardized effect size</td>
<td>Earlier parenting</td>
</tr>
<tr>
<td>Dyer, &amp;</td>
<td></td>
<td></td>
<td>provided in article. Child</td>
<td></td>
</tr>
</tbody>
</table>
Yorgason (2012) self-regulation predicted change in restrictive monitoring, but child self-regulation did not predict change in active media monitoring or deference over time.

Premo & Kiel (2014) NLow threat, supportive: $\beta = .16^*, p > .05.$
High threat, supportive: $\beta = .07^*, p > .05.$
Low threat, non-supportive: $\beta = -.096^*, p > .05.$
High threat, non-supportive: $\beta = .01^*, p > .05.$

Spinrad et al. (2012) N2.5 years to 3.5 years: $\beta = .15, p < .10.$
3.5 years to 4.5 years: Not significant, no effect size provided.

Swanson, Valiente, Lemery-Chalfant, Chalfant, N5 years to 6 years: $\beta = -.02, p > .05.$
Bradley, &
Eggum-Wilkens
(2014)
Taylor, Eisenberg,
Spinrad, &
Widaman
(2013)
Tiberio et al. (2016)

Tiberio et al.
(2016)  Y – conditional
Positive parenting for
teachers (child ages 3 to 5 years): $\beta = .20$, $p < .05$.
Positive parenting for
teachers (child ages 5 to 7 years): $\beta = .09$, $p > .05$.
Positive parenting for
teachers (child ages 7 to 11 years): $\beta = .13$, $p < .05$.
Positive parenting for
teachers (child ages 11 to 13 years): $\beta = -.11$, $p > .05$.
Positive parenting for
fathers (child ages 3 to 5 years): $\beta = .07$, $p > .05$. 

Maternal education, 
household income, 
mother’s marital status, 
child sex, earlier parenting.

Not significant, no effect size provided.
Positive parenting for fathers (child ages 5 to 7 years): $\beta = .08, p > .05$.

Positive parenting for fathers (child ages 7 to 11 years): $\beta = .07, p > .05$.

Positive parenting for fathers (child ages 11 to 13 years): $\beta = .09, p > .05$.

Poor discipline for mothers (child ages 3 to 5 years): $\beta = -.06, p > .05$.

Poor discipline (less) for mothers (child ages 5 to 7 years): $\beta = -.14, p < .05$.

Poor discipline for mothers (child ages 7 to 11 years): $\beta = -.13, p > .05$.

Poor discipline for mothers (child ages 11 to 13 years): $\beta = -.09, p > .05$.

Poor discipline (less) for fathers (child ages 3 to 5 years): $\beta = -.16, p < .05$. 
Poor discipline for fathers (child ages 5 to 7 years): $\beta = -0.05, p > .05$.

Poor discipline for fathers (child ages 7 to 11 years): $\beta = -0.12, p > .05$.

Poor discipline for fathers (child ages 11 to 13 years): $\beta = -0.08, p > .05$.

van der Voort, Linting, Juffer, Bakermans-Kranenburg, & van Ijzendoorn (2013) Y–conditional Infancy to 7 years: Not significant, no effect size provided. Short-term intervention effects on maternal sensitivity in infancy, earlier parenting, child delinquency, child aggression

*Effect size ($\beta$) calculated by first author of current review.

**Findings by Age**

The studies were first grouped so that those examining child effortful control before child age 5-years (early childhood), those examining effortful control between ages 5-years and 10-years (middle childhood), and those examining child effortful control after this age (adolescence) could be compared. These age ranges were chosen because effortful control develops greatly in early childhood, continues to develop in middle childhood, and by adolescence the trait is stable (Mun, Dishion, Tein, & Otten, 2018; Olson, Sameroff, Kerr, Lopez, & Wellman, 2005; Tiberio et al., 2016). Where studies used effortful control as a predictor of a parenting behaviour at multiple time-
points, the study appears in all appropriate categories.

Figure 6. Graph comparing results for studies by age of child at assessment of effortful control.

Comparing the results by child age (see Figure 6) suggests that for studies examining child effortful control before age 5-years, 63% of studies showed at least some support for the effect of child effortful control on parenting, but after child age 5-years this effect slightly reduced to 50% of studies showing at least some support for an effect. For studies examining child effortful control after child age 5-years, whether or not the effect reached significance depended on other factors, typically the parenting behaviour being examined. For example, one study highlighting the importance of the developmental age and the specific parenting behaviours examined (Tiberio et al., 2016) found that different patterns of effects were seen at different ages for the prediction of different parenting behaviours (namely, positive parenting and poor discipline). This difference in patterns of results for this study was further seen for mothers’ versus fathers’ parenting, with mothers’ parenting in this study being more likely to be affected by child effortful control.

Between ages 5- and 10-years, 50% of studies found an effect, with 50% of
studies finding an effect when the child was over 10-years-old. Overall, there doesn’t seem to be much of a difference made by the particular age at which child effortful control is assessed, implying that other factors are involved in determining whether a child-to-parent effect is found or not.

No clear difference in effect sizes was found between the age groups (average $\beta$ for each age range in order: .16, .11, .16).

**Specific Parenting Behaviour**

Results were compared based on the specific parenting behaviour being investigated. First, parenting behaviours or styles were categorised as relating to an aspect of ‘positive parenting’ or ‘negative parenting’ (see Figure 7). When positive parenting was studied, 33% of studies showed these behaviours to be predicted by child effortful control at least some of the time. However, both Tiberio et al. (2016) and van der Voort et al. (2013) found that child effortful control only predicted positive parenting (specifically maternal sensitivity in the case of van der Voort’s study) at certain ages (see Table 5). When parenting behaviours represented an aspect of negative parenting, 79% of studies found at least some support for the hypothesis that child effortful control could predict the parenting behaviour in question. The average effect size for effects on negative parenting behaviours ($\beta = .16$) was only slightly higher than the average effect size for effects on positive parenting ($\beta = .10$).
Figure 7. Graph comparing results for positive versus negative parenting behaviours.

Due to the notable difference in how much child effortful control is seen to affect different parenting behaviours, studies were further compared based on the specific parenting behaviour examined. As there was a great variety of behaviours examined, these results are presented in narrative form alone, without tables. Starting with positive behaviours, parental sensitivity was explored in four studies (Blair et al., 2014; Heatly & Votruba-Drzal, 2017; Spinrad et al., 2012; van der Voort et al., 2013), with three finding support for the influence of child effortful control on parental sensitivity. Less support was found in studies looking at parental warmth, with none of the three studies finding a child-to-parent effect (Eisenberg et al., 2005; Eisenberg et al., 2008; Spinrad et al., 2012). Similarly, little support was seen for studies exploring the impact of child effortful control on parental responsiveness, with only one (25%) of the studies finding any support (Merz et al., 2017), and three studies finding no support (Blair et al., 2014; Brody & Ge, 2001; Kochanska et al., 2004).

Studies exploring the importance of child effortful control for later parental support were divided as to whether they concentrated on the positive act of supporting their child or whether the focus was on unsupportive behaviour. For all three of these
studies, child effortful control did not predict parental support (Hong et al., 2015; Klein et al., 2018; Premo & Kiel, 2014).

Mixed support was provided for child effortful control predicting teaching behaviours or involvement in child education. Two studies measuring parenting behaviours at child age 6-years-old and 8-years-old respectively found no support for prediction of such parenting behaviours from earlier levels of child effortful control (Abenavoli et al., 2015; Garbacz et al., 2016). However, Eisenberg et al. (2010) found that child effortful control predicted later cognitive assistance, directive teaching strategies, and maternal questioning when both effortful control and parenting behaviours were assessed between child ages 18-months and 42-months (with the exception that child effortful control no longer predicted maternal questioning from 30-months to 42-months).

As expected after the overall negative parenting results, greater support was provided for studies exploring negative behaviours. Specifically, harsh discipline was seen to be predicted by earlier levels of child effortful control for all six studies exploring this behaviour (Barnes et al., 2013; Baron & Malmberg, 2019; Brody & Ge, 2001; Cecil et al., 2012; Eisenberg et al., 1999; Lee et al., 2013). However, for two of these studies, harsh discipline was only seen to be predicted by effortful control at the earlier time-points in each study (Baron & Malmberg, 2019; Eisenberg et al., 1999). A similarly high level of support was seen for the impact of child effortful control on later controlling parenting behaviour, with five out of six studies showing support (Eisenberg et al., 2015; Hong et al., 2015; Lee et al., 2013; Padilla-Walker & Coyne, 2011; Padilla-Walker et al., 2012; Taylor et al., 2013). Only one study explored the relation of child effortful control to later parental rejection, but this did find support for the child-to-parent effect (Lengua, 2006). Inconsistent parenting, on the other hand, was
not seen to be predicted by child effortful control (Lengua, 2006; Lengua & Kovacs, 2005).

**Study Design**

Studies were compared based on whether they used questionnaires to measure child effortful control or either lab-tasks or experimenter observations (see Figure 8). As few studies used observation or lab-tasks to examine effortful control, and due to the overlapping nature of these methods for some studies, these methods were considered together. Eighteen studies used questionnaire methods to assess child effortful control, seven used lab-tasks or observation, and three used a combination of these methods.

The method used to measure child effortful control made a substantial difference to the study results, with 72% of studies showing at least some support of the child-to-parent effect when questionnaires were used, compared to 43% of studies when observational or lab-task data was used. Out of the three studies that combined questionnaire data with data from a lab-task only one found any effect of child effortful control predicting parenting behaviours. For studies using questionnaire methods to measure child effortful control, the age of the child at assessment and the specific parenting behaviour examined were key determinants of whether a significant effect would be found.

No real difference in effect size was seen between studies using questionnaires to assess child effortful control (average $\beta = .13$) and those employing lab-tasks or observational methods (average $\beta = .09$). However, mixed methods, despite only one study finding significant child-to-parent effects, had an average effect size ($\beta$) of .29.
Figure 8. Graph comparing results for studies based on methodology used for child effortful control.

Studies were next compared based on whether questionnaires or observations were employed to measure parenting behaviours. Figure 9 shows the findings based on parenting methodology. Fourteen studies used questionnaire methods to assess parenting, ten used observation, and four used a combination of these methods. For studies that used questionnaires to measure parenting, 61% found support for child-to-parent effects in at least some contexts. For studies using observational measures of parenting, 50% of studies found at least some support for child-to-parent effects. Only one study used mixed (combined) methods to measure parenting, and this found partial support (not included in graph as only one study in the category). Again, for those studies that used questionnaires to measure parenting, the particular parenting behaviour examined was an important determinant of whether a significant effect was found. Effect sizes were slightly higher when observational methods were used to assess parenting (average $\beta = .20$) than when questionnaires (average $\beta = .12$) or mixed methods (average $\beta = .11$) were used.
Studies were next compared based on whether the child and parent assessments shared the same methodology (i.e. questionnaires or observations/lab-tasks for both child and parent assessments). Most of the studies used shared methodology for at least one child-to-parent effect reported in the paper. When studies used questionnaire methods for both the child and parent measure (n=14), 79% of studies found a significant child-to-parent effect. Similarly, when studies used observations or lab-tasks for both the child and parent measure (n=5), 60% of studies found a significant child-to-parent effect. When mixed methods were used (n=12), however, only a third of studies found a significant child-to-parent effect.

To examine the impact of shared rater bias on study findings, studies using only questionnaire methods were compared based on whether both child and parent measures were reported by the same informant or not. Firstly, most of these studies used parent reports only, with only two studies using child and parent combined reports, one study using combined mother and father reports, and only two studies using different informants for the child and parent questionnaires. No difference was noted between questionnaire studies using only parent report and those using combined reports or

Figure 9. Graph comparing results for studies based on methodology used for parenting.
different informants for parent and child measures (78% of parent only reports vs. 80% of combined or different informant reports).

Studies that explored both child-to-parent and parent-to-child effects were compared to those solely examining child-to-parent effects (see Figure 10). If significant parent-to-child effects exist between the ages examined, then including this path in the model could reduce the size of the child-to-parent effect estimated. On the other hand, if the direction of effects between child and parent behaviours is not (at least solely) from parent to child then the child-to-parent effect should still remain. By comparing studies exploring bidirectional effects and child-to-parent effects, it was found that 67% of studies exploring solely child-driven paths found support for such paths, and for studies also testing for parent-to-child paths this slightly reduced to 58%. It’s important to note here that before the addition of Garbacz et al. (2016), which didn’t include the path from child effortful control to parental education involvement in the final regression model due to non-significant results earlier in the model building process, the difference between these groups of papers was greater. As this child-to-parent effect doesn’t typically disappear when parent-to-child effects are controlled for, it is likely that child-to-parent effects do exist between child effortful control and parenting behaviours. Effect sizes for each type of study were also not substantially different, varying more within groups than between (average $\beta$ for child-driven models = .13; average $\beta$ for bidirectional models = .14).
Discussion

The current review explored studies that examined the potential impact of child effortful control, the ability to withhold unhelpful responses in favour of appropriate behaviours and to focus one’s attention to a particular source of interest, on later parenting behaviours. Twenty-eight published studies were found to explore this relationship longitudinally. Average reported effect sizes were typically relatively low (average $\beta$ when considered significant = .21; average $\beta$ when not considered significant and still reported = .08). Most of these studies (17/28) found some kind of support for a child-to-parent effect, but whether or not a significant effect was found depended on several factors that were explored in this review. Although there seemed to be no difference made to the results by the age of the child, a significant child-to-parent effect was more likely when questionnaires were employed and where negative, rather than positive, parenting was explored.

Firstly, differences were seen for studies examining different parenting behaviours. Overall, poorer child effortful control was more closely associated with

Figure 10. Graph comparing results for studies exploring bidirectional or child-to-parent effects.
eliciting negative parenting attributes than higher levels of child effortful control were for positive parenting attributes. Similar findings were seen for the effects of parenting on child self-regulatory abilities, with a previous meta-analysis finding that the strength of relationships between parenting behaviours and child self-regulation varied depending on how both parenting and self-regulation was operationalised (Karreman, van Tuijl, van Aken, & Deković, 2006). Given the results of the aforementioned meta-analysis, it is unsurprising that child-to-parent relationships also vary depending on which parenting behaviours are being examined. This effect may in part be due to a measurement effect if negative behaviours are easier to identify and code than positive behaviours, but research into such coding differences would be needed for any conclusions to be made.

No difference was found when categorising studies by age. The lack of a clear difference in effects for younger and older children across the literature may be in part due to the constantly shifting dynamics within the family, with different parent or child attributes playing a greater role in influencing child or parent behaviours at different stages of child development (e.g. Serbin et al., 2015). It may be that by grouping findings from studies looking at different parenting behaviours together, no difference across ages can be seen. If a larger number of studies were available, it may have been possible to compare findings by age whilst also separating studies by parenting behaviour; by comparing the results in such a way it would be possible to see whether different patterns exist for different parenting behaviours, with some parenting behaviours being influenced more at certain stages of child development. This idea is supported by evidence from a review of genetically sensitive studies of parenting that found that heritability estimates change between infancy and later childhood (Pike & Oliver, 2015); this pattern suggests that genetically informed child traits may have a
greater influence on a parent’s behaviour towards the child at different points in
development.

Study design may also play a role in determining the likelihood of finding a
significant child-to-parent effect. In particular, the methodology used to examine child
effortful control and whether or not the same methods were used to examine both child
effortful control and parenting seemed to play a role in determining whether or not a
study would find a significant child-to-parent effect. However, there was not enough
evidence in the present review to conclude that shared rater bias affected the likelihood
of finding a significant effect; out of the questionnaire studies, only two had different
reporters completely, and only three had combined accounts. The finding that studies
using shared methods for both child and parent assessments are more likely to find
significant child-to-parent effects was expected given that previous research has found
shared methods to find a closer association between parenting and child attributes
within the same sample (Karremans, Tuijl, Van Aken, & Dekovic, 2008).

There was no real difference in results for studies testing for bidirectional effects
or child-driven paths only. As most papers finding non-significant main effects aren’t
published, it is not possible to calculate the true extent of the effect of child effortful
control on parenting behaviours. If a large difference had been noted between studies
controlling for previous parenting behaviours and those not, then it could be determined
that a significant amount of the variance in child-driven path models could be better
explained by a parent-to-child effect. Without testing for a direction of effect it should
not be assumed that either parent-to-child or child-to-parent effects solely are present
(Bell, 1968). It should be noted that although most of the studies also examining a
parent-to-child effect found a significant parent-to-child effect (13/19), not all did; for
some of the studies where there was no evidence for a parent-to-child effect, a child-to-
parent effect was supported. As suggested above, it seems likely that transactional models of parenting and child development are most accurate, with different parenting behaviours having different directions of effects with child effortful control at different points in development.

There is clearly some evidence that child effortful control can predict later parenting behaviours, but evidence for an effect is particularly dependant on the parenting behaviour being examined. Sometimes whether or not a significant effect is found may depend on only slight changes to a full path model. For example, Taylor et al. (2013) and Eisenberg et al. (2015) likely used overlapping samples and applied similar path models, however, only one of these papers found a significant child-to-parent effect. Although for these studies the age ranges differed, there was an overlap of child age investigated, with the same path between child effortful control and intrusive parenting examined between ages two-and-a-half and three-and-a-half years. For the study that did find a significant effect (Eisenberg et al., 2015), the effect size was still reasonably small ($\beta = -.20$). This small effect size was not uncommon amongst the studies included in this review. Bearing in mind that for the majority of studies that did find a significant child-to-parent effect, most of these reported small effect sizes, perhaps traditional null hypothesis significance testing (NHST) is no longer an acceptable method of analysis. Although the current review does not aim to discuss in length the appropriateness of using significance levels alone to determine the presence or absence of an effect or developmental pathway, if very slight changes to a path model can completely change the interpretation of the results, then perhaps researchers need to move towards a system where we refer to the strength of evidence, as indicated by the effect size calculated. It was clear in the preparation of the current review that sample size played the greatest role in whether or not a significant effect was reported; larger
effect sizes were required by studies with smaller sample sizes in order for an effect to be considered significant. The studies with smaller samples that did not report a significant child-to-parent effect may have found an effect if their sample sizes had been adequate. Indeed, often studies find that by including a non-significant path in a model the model fit is improved, despite the path not reaching traditional significance levels (e.g. Spinrad et al., 2012); in these cases the addition of the path explains further variance in the model, yet there is not enough evidence to conclude that the predictor has a significant influence on the outcome variable.

The relatively small effect sizes produced by the majority of the studies included in the current review are not too surprising, given the longitudinal nature of the studies; over time it would be expected that a number of influences would have an effect on parent behaviours, including child attributes other than effortful control. The effect sizes calculated for these studies clearly suggest that although child effortful control does play a role in shaping parenting behaviours, this is not the only predictor of any parenting behaviour, and a combination of parent, child, and other environmental factors is likely to be involved.

**Implications**

Research exploring the role of parenting in child development clearly needs to consider the impact of prior child attributes on parenting, as the direction of effects between parent and child behaviours may not necessarily always be from parent to child. Despite the mixed evidence in the literature base, there is reasonable evidence that early child effortful control can influence later parenting behaviour. It is particularly important that studies using a cross-lagged design, and thus testing for a direction of effects, have also provided evidence for a child-to-parent effect. Research
should thus take in account potential bidirectional relationships between child and parent behaviours when designing longitudinal studies to explore developmental cascades.

The evidence reviewed in this paper highlights the influence that child attributes, such as child effortful control, can have on certain parenting behaviours. This evidence has implications for parenting interventions. Parenting interventions and advice need to be mindful of language use and the assumptions made; some parents are likely to find inhibiting particular unhelpful responses more challenging themselves, and a clear awareness that challenging child attributes can provoke less adaptive parenting behaviours is important. Parenting interventions and literature may then be more helpful when they use language that does not suggest blame, but instead provide guidance on how to cope with particularly challenging child behaviour and include sessions on self-care. In one evaluation of a parenting programme designed for adoptive parents, parents discussed that they found it helpful to speak about self-care and coping with challenging child behaviours but expressed that it would have been helpful if there was a greater focus on self-care throughout the programme (Harold, Hampden-Thompson, Rodic, & Sellers, 2017).

Limitations

As noted above, literature reviews are always likely to be affected to some extent by publication bias. As most papers that don’t find a significant effect are unlikely to get published, it is not possible to know whether the supportive papers detailed above are in the minority. Unless a move towards pre-registration as standard practice occurs and papers revealing non-significant results are published, this limitation will continue to impact reviews and our understanding of topics.
This review, in particular, is limited by the great variation in definitions of both effortful control and specific parenting qualities. Great effort was taken by the authors to ensure that appropriate papers were included in the review. However, as the definition of effortful control varies between researchers, only one definition could be used to compare studies. Initial reviews of the literature conducted by the first author indicated that most definitions of effortful control used by researchers included the components of inhibitory control and attentional control, and thus it was decided that only papers exploring these key components would be included in this review. As a result, some papers that referred to effortful control but used measures that did not fall under this definition were excluded from the present review (i.e. Kotila, Schoppe-Sullivan, & Kamp Dush, 2014; Li, Pawan, & Stansbury, 2014; Wilson & Durbin, 2012).

Similarly, studies have used different definitions of parenting attributes. However, for the sake of the current review, papers were categorised based on what behaviour the paper claims is being examined. It is possible that differences between papers looking at the same parenting behaviour are partly due to measurement differences. Some studies have also used age ranges that overlapped at each time-point; for example, Lengua and Kovacs (2005) collected data from children between ages 7 to 11 years, with the second data collection point one year later when the children were 8- to 12-years-old. It’s difficult to establish whether certain effects exist at a particular point in development if the sample varies more in age within each time-point than between them.

Finally, all of the studies bar one in the current review use biologically related parent-child dyads. When parents and children are biologically related, it is possible that any reported relationship between child and parent attributes has arisen as a result of shared genes influencing both behaviours; this is a phenomenon called passive gene-environment correlation (Harold et al., 2013). Interestingly, the sole study in this review
that used an adoptive sample (van der Voort et al., 2013) found that poorer child effortful control in infancy predicted greater positive parenting behaviour when the child reached adolescence, in contrast to the other evidence. It seems that in a sample where genetic influence was removed, parents were more sensitive to the children’s needs. Perhaps, then, the negative evocative effect of poor child effortful control on parenting is largely due to genes associated with poor self-regulation; however, this finding would need to be replicated using other genetically sensitive samples before any such conclusion could be formed. It is also possible that this finding is due to the adoptive parents in the sample having been approved as adoptive parents due to likely parenting competence and ability to provide a positive environment for the child (Castle, Beckett, Rutter, & Sonuga-Barke, 2010). More research is thus needed to understand whether it is shared genes that plays the greatest role in the prediction of child self-regulation.

**Future Research**

Future research into the importance of parenting for child development should take into account previous child attributes in order to establish a direction of effects. There is evidence that bidirectional relationships between child and parent attributes form a developmental cascade of effects (Cox, Mills-Koonce, Propper, & Gariépy, 2010; Perry, Dollar, Calkins, & Bell, 2018), leading early life experiences to have knock-on effects into later life. It is important for both child and parent wellbeing to continue research into possible bidirectional effects between child effortful control and parent behaviours, as evidence has shown certain parenting behaviours to be associated with later child self-regulation (Baron & Malmberg, 2019; Cecil et al., 2012; Fay-Stammbach et al., 2014), and poor child self-regulation has further been associated with increased parenting stress (Joyner, Silver, & Stavinoha, 2009; Paley, O’Connor,
Frankel, & Marquardt, 2006). Equally, research into alternative predictors of parenting behaviours would also help to inform both further research and parenting interventions. It is possible that some parents are more acutely affected by a child’s poor self-regulation than others, and research illuminating which groups might be most affected by challenging child behaviours and potential buffers against such effects would be valuable. So although effect sizes are small and effects don’t always reach traditional significance levels, when separating the sample into certain groups, it may be that certain groups are more intensely affected by child attributes. It is possible that the influence of child attributes interact with parent attributes, with parents with particular personality traits more likely to be affected more by the child’s attributes (e.g. Hong et al., 2015). It is also possible that the parent’s own self-regulatory abilities play a role in how much their parenting behaviours are affected by their child’s attributes (Valiente, Lemery-Chalfant, & Reiser, 2007). Given the mixed literature base presented in this review, it seems likely that child effortful control is just one of many factors that could influence parenting behaviours, and further research into predictors of parenting behaviours is required to help to develop both understanding on the topic and parenting interventions.

**Conclusion**

Although the evidence was mixed, overall there was a suggestion that child effortful control can predict certain later parenting behaviours. In particular, poorer child effortful control was associated with later negative parenting behaviours. Although much research has examined the influence of negative parenting behaviours on child effortful control development (Bridgett et al., 2015), scant research has looked at bidirectional effects. Whether or not a study concludes that parenting behaviours are predicted by earlier child effortful control depends largely on the size of the sample, the
parenting behaviour being examined, and the methodology used to measure both child
and parent behaviours. Future research examining the impact of parenting on child
development needs to take potential evocative child-driven effects into account.
Chapter 4:

Parent-to-Child and Child-to-Parent Effects in the Development of Child Attentional and Inhibitory Control and ADHD Symptoms

Simcock, V. E., Cartwright-Hatton, S., & Pike, A.

Author Note

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Abstract

Child attentional and inhibitory control are regarded as core difficulties for children with symptoms of ADHD. Associations between parenting behaviours and child ADHD symptoms and child attentional and inhibitory control have been well-established in past literature. However, it is possible that these associations may be bidirectional in nature. The current study aimed to explore parental predictors of child attentional and inhibitory control and ADHD symptoms, and parenting behaviours that may be elicited by poorer child attentional and inhibitory control. The study used a large UK longitudinal sample (ALSPAC) to test a developmental cascade model. Parenting behaviours at 5-years and 12-years were assessed using observational methods, child attentional and inhibitory control were assessed using laboratory tasks, and child and mother psychopathology were assessed using parent-report questionnaires. Limited evidence was found for associations between parent and child variables, with most associations failing to reach significance; however, weak evidence was provided for a child-to-parent effect of child inhibitory control on parent-to-child hostility. Results further indicated that the attentional control measure may provide a better indicator of risk for later child ADHD than the inhibitory control measure, yet this association may be partly explained by child general cognitive ability. Whether significant paths were found or not was affected by which other factors were included in the model and whether IQ was controlled for. Implications of the results and limitations of the study are discussed.
Parent-to-Child and Child-to-Parent Effects in the Development of Child Attentional and Inhibitory Control and ADHD Symptoms

Childhood symptoms of attention-deficit/hyperactivity disorder (ADHD) can have profound long-term consequences for later life outcomes (Ingram, Hechtman, & Morgenstern, 1999). It is thus important to identify antecedents of such symptoms in order to understand what interventions should focus on, and when in development it would be most appropriate to deliver these interventions. The current study aimed to test a developmental cascade model of predictors of ADHD symptoms, with a particular focus on the importance of possible bidirectional effects between parenting behaviours and child attentional and inhibitory control.

Attention-Deficit/Hyperactivity Disorder (ADHD) and Effortful Control

ADHD is defined by symptoms of inattention and/or hyperactivity and impulsivity. Children expressing symptoms of ADHD often experience difficulties in both academic and social settings, with DSM-5 criteria listing such difficulties as a requirement for clinical diagnosis (American Psychiatric Association, 2013).

Research has identified poor effortful control as central to ADHD (Nigg, Goldsmith, & Sachek, 2004). Effortful control comprises attentional control (the ability to shift and focus one’s attention onto a particular source) and inhibitory control (the ability to restrain from producing inappropriate responses) (Liew, 2012). Individuals with ADHD may find it difficult to focus on a set task for a prolonged period of time and may be less likely to think through actions before performing them (American Psychiatric Association, 2013). As well as having been linked to ADHD, poorer effortful control has also been associated with other adverse outcomes, such as
difficulties at school (Gilmore et al., 2013; Kim, Nordling, Yoon, Boldt, & Kochanska, 2013; Rimm-Kaufman, Curby, Grimm, Nathanson, & Brock, 2009), poorer psychological functioning (Muris, 2006; Muris, van der Pennen, Sigmond, & Mayer, 2008), social skill deficits (Eisenberg, Liew, & Pidada, 2004; Lengua, Honorado, & Bush, 2007), and even impaired moral development (Kochanska, Murray, & Coy, 1997; Rothbart, Ahadi, & Hershey, 1994).

The Role of Parenting in Child Effortful Control Development

Parenting has been shown to play an important role in the facilitation of child effortful control development (Fay-Stammbach et al., 2014; Karreman, van Tuijl, van Aken, & Deković, 2006). In particular, parental use of scaffolding behaviours, which include behaviours aimed at assisting child regulation and taking into account child ability to complete the task on their own (Bibok, Carpendale, & Müller, 2009; Leith, Yuill, & Pike, 2018), has been associated with healthy development of self-regulatory abilities, such as effortful control (Lengua et al., 2007). For example, scaffolding, structuring, and reasoning behaviours observed at ages 2- and 3-years have been associated with later child effortful control at age 5-years (Chang, Shaw, Dishion, Gardner, & Wilson, 2015). Similarly, parental use of elaborative instruction relating to the task the child is engaged in is associated with healthier development of child effortful control (Bibok et al., 2009).

Although parental use of scaffolding behaviours is associated with better child effortful control, too much assistance or over-control on the part of the parent is associated with poorer child effortful control (Grolnick & Farkas, 2002; Karreman, van Tuijl, van Aken, & Dekovic, 2008; Kochanska, Aksan, Prisco, & Adams, 2008). Whereas scaffolding provides children with opportunities to develop self-regulatory
skills, when parents assert too much control they limit these opportunities for children to develop their own self-regulation and continue to rely on other-regulation.

It is also possible that the development of the two key elements of effortful control, namely inhibitory control and attentional control, are associated with different parenting attributes. The development of child inhibitory control, for example, has been associated with fewer harsh paternal discipline behaviours (Lucassen et al., 2015), greater parental responsiveness to the child (Merz, Landry, Montroy, & Williams, 2017), and parental support and limit setting (Schroeder & Kelley, 2010). Child attentional control, on the other hand, has been associated with maternal behaviours aimed at facilitating learning (Mezzacappa, Buckner, & Earls, 2011) and lower maternal control (Gaertner, Spinrad, & Eisenberg, 2008).

**Role of Child Effortful Control in Predicting Parenting**

However, it is likely that the direction of effects between child attributes and parenting behaviours is not always from parent to child. Bell (1968) first drew attention to the notion that, as correlation does not equate to causation, cross-sectional, correlational studies of relationships between parenting behaviours and child characteristics can not accurately conclude a parent-to-child direction of effects; instead, a child-to-parent direction of effects is entirely possible. Other researchers have acknowledged the potential for child-to-parent effects, with Belsky (1984) identifying child characteristics as a key determinant of parenting behaviour. There is now increasing evidence of bi-directionality. In particular, the evidence suggests that parenting behaviours may be influenced by a child’s effortful control, with poor child effortful control being associated with increased parental control (Eisenberg, Taylor, Widaman, & Spinrad, 2015; Hong et al., 2015), later parental rejection (Lengua, 2006),
and harsh or hostile parenting, low in emotional warmth (Baron & Malmberg, 2019; Cecil, Barker, Jaffee, & Viding, 2012; Eisenberg et al., 1999). Although excessive parental control has been implicated in the development of poorer child effortful control, it is possible that increased parental control can be in response to the child presenting difficulties in self-regulation, with the parent stepping in to assist the child (Leith, Yuill, & Pike, 2018). Evidence for this direction of effects comes from several longitudinal studies (Eisenberg et al., 2015; Hong et al., 2015; Padilla-Walker & Coyne, 2011; Padilla-Walker, Coyne, Fraser, Dyer, & Yorgason, 2012). There is also evidence that poorer child self-regulation can elicit greater negative parenting behaviours from parents (Freeman, Johnston, & Barth, 1997). For instance, poor child effortful control has been seen to predict harsh parenting practices (Baron & Malmberg, 2019; Brody & Ge, 2001; Cecil et al., 2012; Eisenberg et al., 1999).

**Parental Anxiety Affecting Parenting and Child Outcomes**

Parental psychopathology has previously been shown to be associated with both parenting behaviours and child developmental outcomes (Chronis-Tuscano, Danko, Rubin, Coplan, & Novick, 2018; Pemberton et al., 2010; Stein et al., 2014). Parental anxiety plays an important role in the prediction of child psychopathology (Eley et al., 2015; Glover, 2014; Murray et al., 2008). In particular, maternal stress or anxiety during pregnancy is associated with later child outcomes. For example, increased mother stress during pregnancy has been associated with later ADHD symptoms in children (Talge, Neal, Glover, & Early Stress, Translational Research and Prevention Science Network, 2007). Similarly, antenatal anxiety symptoms at 16 weeks gestation were shown to be associated with child ADHD symptoms, problem behaviours, and emotional and social difficulties at age 5-years in a large longitudinal study in the Netherlands (Loomans et al., 2011). In a previous analysis using the ALSPAC sample, mother anxiety at 32
weeks gestation was shown to be associated with later child ADHD symptoms at age 8-years (van den Bergh & Marcoen, 2004). Parental anxiety has further been associated with child self-regulatory abilities, such as attentional control (van den Bergh et al., 2006).

As well as evidence of direct associations between parent anxiety on child developmental outcomes, there is evidence of parental anxiety influencing parenting behaviours produced. Research has revealed links between parental anxiety and parenting behaviours such as overinvolvement (Möller, Majdandžić, & Bögels, 2015) or overprotection (Clarke, Cooper, & Creswell, 2013). There is some evidence that parental perfectionism may act as a linking mechanism through which parental anxiety influences parental overcontrol (Affrunti & Woodruff-Borden, 2015). Through both direct links and indirect links via parenting, maternal anxiety may, then, influence the development of child ADHD symptoms, and the self-regulatory abilities associated with the development of these symptoms.

**Current Study**

Although research has shown parenting behaviours and child attributes to influence one another, the evidence exploring bi-directional effects between parenting and child effortful control is limited. Previous studies also very rarely break down effortful control into the main components of attentional control and inhibitory control to test whether these components are predicted by, or predictive of, different parenting behaviours in the same study. Furthermore, previous research exploring links between child effortful control and parenting behaviours has typically used questionnaire methods.
The current study aimed to test a developmental cascade model of both predictors of child attentional and inhibitory control and parental responses that may be elicited by these attributes, as well as exploring how these abilities and parenting behaviours relate to child ADHD symptoms. Parenting behaviours are assessed using structured observations and child attentional and inhibitory control are assessed using experimental methods (laboratory-based tasks). Parental anxiety is further explored as a potential predictor of parenting behaviours and child effortful control. Based on findings presented in previous literature, it was hypothesised that both attentional and inhibitory control would be associated with later ADHD symptoms and with one another. It was further expected that parental anxiety would influence parenting control, and that attentional and inhibitory control would be associated with parenting behaviours. A theoretical model that guided the analyses is presented in Figure 1.1.

![Theoretical model](image)

**Figure 1.1.** Theoretical model.
Method

Participants and Study Design

The sample were part of The Avon Longitudinal Study of Parents and Children (ALSPAC) (Boyd et al., 2013; Fraser et al., 2013). ALSPAC is a large, UK longitudinal study that recruited pregnant women with delivery due dates between April 1991 and December 1992 living in the Avon area, South-West England. The study recruited 15,454 pregnant women, with 14,901 children alive at 12 months. Of this sample, 10% of families were invited to take part in clinic visits, which included observational tasks assessing parenting behaviours. Approximately half of the total sample attended clinics at child ages 8- and 10-years, when child attentional and inhibitory control were assessed, respectively. To reduce rates of missingness, the current analysis includes the 437 child-parent dyads who completed both the TIM interaction task assessing parenting behaviours at 5-years, the selective attention task at 8-years, and the Etch-a-Sketch parent-child task at 12-years. The reduced sample did not differ from the original sample when comparing families based on the sex of the child, child general cognitive ability, child ADHD symptoms at 13-years, or child attentional control and inhibitory control scores. However, this reduced sample did have slightly lower mother anxiety ratings ($M = 4.37, SE = .17$; full sample, $M = 5.16, SE = .03$; $t(11778) = 4.31, p < .001$) and a slightly reduced chance of the parent showing hostility towards the child in the Etch-a-Sketch task ($M = 1.98, SE = .01$; full sample, $M = 1.96, SE = .002$; $t(474.5) = -2.996, p = .003$).

Please note that the study website (http://www.bristol.ac.uk/alspac/researchers/our-data/) contains details of all the data that is available through a fully searchable data dictionary and variable search tool. Ethical approval for the study was obtained from the
ALSPAC Ethics and Law Committee and the Local Research Ethics Committees.
Informed consent for the use of data collected via questionnaires and clinics was obtained from participants following the recommendations of the ALSPAC Ethics and Law Committee at the time.

Measures

**Prenatal: Mother anxiety.** Prenatal anxiety in mothers was assessed with a modified version of the anxiety scale of the Crown-Crisp Experiential Index (CCEI; Crown & Crisp, 1979) at 32 weeks gestation. Eight self-report questions assessed the frequency of anxiety symptoms on a 4-point scale from ‘never’ to ‘very often’. The scale showed very good reliability (α = .81), and has been previously validated (Alderman, Mackay, Lucas, Spry, & Bell, 1983).

**5-years: Parenting.** To assess mothers’ parenting behaviours at child age 5-years (61 months), a modified version of the Thorpe Interaction Measure (TIM; Thorpe, Rutter, & Greenwood, 2003) was employed. The TIM involves a filmed observation of a parent-child interaction involving a picture book with photographs of children roughly the same age as the children taking part in the observation task. A number of parenting behaviours were coded from the observation; the current analysis utilises observer ratings of scaffolding behaviours and parental control.

Scaffolding behaviours coded in the TIM include labelling, short elaboration (summarising of the content of the picture), long elaboration (inferences that could be made), noting descriptive features, placing in the context of the child’s own experience, and encouraging child involvement. A Principal Components Analysis suggested the removal of the child involvement code and the addition of a further code; ‘mother motivated’ assessed the extent to which the mother attempted to motivate the child
during the task. The final scaffolding variable included mean scores on each of the aforementioned behavioural codes. Reliability in the current sample was $\alpha = .61$.

Parental control was rated on a 5-point-scale. Low (raw, unadjusted) scores indicated greater parental control and high (raw, unadjusted) scores indicated higher child control than parental control.

**8-years: Child attentional control.** The laboratory task used to assess child attentional control at age 8 years was part of a battery of tasks from the Test of Everyday Attention for Children (TEA-Ch; Manly, Robertson, Anderson, & Nimmo-Smith, 1998; Manly et al., 2001). The ‘Sky Search Task’ was selected to evaluate child selective attention. The children were asked to identify and circle pairs of identical spaceships on a page containing images of spaceships as quickly as possible without making any mistakes. Twenty target pairs were distributed around the 108 distractor pairs. The child marked the completion of the task by marking a box in the corner of the sheet to indicate that they had checked for errors or missed pairs and believed that they had finished the task. Initial mistakes meant that the task took longer for these children. The final score was the time taken to complete the task, adjusted to take motor speed into account; motor speed was calculated immediately after this task using a version of the Sky Search Task without the non-identical distractor spaceship images.

**10-years: Child inhibitory control.** Child inhibitory control at age 10 years was measured with the Stop Signal Task (Logan, Cowan, & Davis, 1984; Aman, Roberts, & Pennington, 1998). The children were asked to sit in front of the computer and place one index finger in a stimulus box labelled ‘X’ and place their other index finger in a stimulus box labelled ‘O’. The children were first asked to press the corresponding button when either an ‘X’ or ‘O’ appeared on the screen in front of them.
During this initial task, each child’s reaction time was recorded. The children were next told to repeat the previous instructions, but when a bleep sound was heard the children were asked to inhibit their previously learned response and not press any button. The bleep sound was played on random trials (16 out of the 48 trials) 150 ms before each child’s previously calculated reaction time. As suggested by Handley and colleagues (Handley, Capon, Beveridge, Denis, & Evans, 2004), accuracy in the Stop Signal Task was taken as the measure of inhibitory control.

**12-years: Parenting.** To assess parenting behaviours at 12 and a half years, interactions were observed during the Assessment of Mother-Child-Interaction with the Etch-a-Sketch (AMCIES) protocol (Wolke, Rios, & Uzner, 1995). The task involved the parent and child dyads working together to draw a picture of a house on the Etch-a-sketch programme on the computer. The child was directed to control the vertical lines, and the parent was tasked with drawing the horizontal lines. The dyad were both required to use the Etch-a-Sketch controls when drawing the diagonal or circular lines on the template.

Parental control was assessed using combined codes of verbal control, non-verbal control, and control over the interaction outcome. Verbal control was measured on a 5-point scale, from very low to very high, capturing the extent that the parent used controlling language that aimed to change the child’s behaviour. Similarly, non-verbal control was measured on the same 5-point scale, and captured the extent to which the parent physically took over control of the child’s key on the keyboard, pointed something out on the screen or pointed at the child’s key, or moved the child’s hands. The code ‘control over the interaction outcome’ assessed whether the parent or the child was more in control of the session, with scores on a 5-point scale ranging from the child being in clear control of the session to the adult being in complete control of the
session; the score depended on whose instructions were most complied with. An overall parental control score combined scores from these three observational codes, with a reliability of $\alpha = .63$. Low scores on this combined variable indicated low parental control exerted over the child, and high scores indicated high levels of parental control.

Parent-to-child hostility was coded as present when the parent criticised the child or their performance in the task or became clearly irritated by the child. This was a dichotomous variable (‘yes’/’no’) indicating whether the coders perceived the parent to behave harshly towards the child by giving a particularly negative comment directed at the child or their performance during the interaction task.

**13-years: Child attention-deficit/hyperactivity disorder symptoms.** A parent-report questionnaire version of the Development and Well-Being Assessment (DAWBA; Goodman, Ford, Richards, Gatward, & Meltzer, 2000) was used to assess child ADHD symptoms at 13 and a half years (166 months). The symptom count, rather than the clinical cut-off point, was utilized, with high scores indicating greater symptom severity. Reliability for the scale was excellent ($\alpha = .94$).

**Covariate: Child general cognitive ability.** Child IQ at child age 8-years was used as a covariate in the analyses, due to the association between general cognitive ability and executive functioning (Bernier, Carlson, Bordeleau, & Carrier, 2010), to ensure that any associations between attentional or inhibitory control and other variables in the analyses were not an effect of intelligence, and were specifically due to attentional and/or inhibitory control. The WISC-III UK (Wechsler, Golombok, & Rust, 1992) assessed total child IQ (with sub-tests measuring verbal and performance ability).
Statistical Analysis.

Firstly, correlations were conducted between variables. Due to missing data across assessments, the dataset was imputed with Multiple Imputation by Chained Equations (MICE). Twenty datasets were imputed using STATA version 13 (StataCorp, 2007). Next, path analyses were conducted with Mplus version 8 (Muthén & Muthén, 1998) to test the relationship between parent and child attributes in the development of child self-regulatory abilities. Four separate path models were calculated with parental control and scaffolding behaviours as predictors of child attentional and inhibitory control, and with parental control and parent-to-child hostility modelled as parenting behaviours predicted by these child attributes. Signs were reversed for child attentional control, parent-to-child hostility, and parental control at 5-years as appropriate so that high scores of child inhibitory control and attentional control indicated better effortful control and higher scores on parenting variables indicated increased levels of the indicated behaviours (i.e. greater control or increased parent-to-child hostility). Child gender was considered as a possible moderator of the models.

Results

Preliminary Analyses

Listwise correlations were conducted with the raw variables and are presented in Table 6. Most of the variables were unrelated to one another for this sample when using listwise methods. However, there were associations between mother anxiety and child ADHD symptoms, between maternal control and maternal scaffolding when both measured at child age 5-years, between maternal control at 5-years and parental control at 12-years, and between child attentional control and child ADHD symptoms. There were also some trends seen between maternal scaffolding at 5-years and parental control
at 12-years, between child attentional and inhibitory control, between child inhibitory control and parent-to-child hostility, and between parent-to-child hostility and child ADHD symptoms.

Table 6

*Correlations Between Variables*

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<td>2. Maternal Control</td>
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<td>at 5-years</td>
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<td>3. Maternal Scaffolding at 5-years</td>
<td>-.03</td>
<td>.24**</td>
<td>-</td>
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<td>4. Child Attentional Control</td>
<td>-.03</td>
<td>-.01</td>
<td>.07</td>
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<td>5. Child Inhibitory Control</td>
<td>&lt;.01</td>
<td>-.03</td>
<td>-.05</td>
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<td>6. Parental Control</td>
<td>.05</td>
<td>.13*</td>
<td>.09†</td>
<td>-.04</td>
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<td>at 12-years</td>
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<td>7. Parent-to-child</td>
<td>.06</td>
<td>.02</td>
<td>-.04</td>
<td>-.01</td>
<td>-.10†</td>
<td>.05</td>
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<td>hostility at 12-years</td>
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<td>8. Child ADHD</td>
<td>.18**</td>
<td>.02</td>
<td>.01</td>
<td>-.15**</td>
<td>-.04</td>
<td>-.01</td>
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†p < .10; *p < .05; **p < .01.
Path Analyses

Model 1: Parental control with parental control. For the model with parental control included at both 5-years and 12.5-years, poor model fit was initially returned ($x^2(3) = 7.92$, $p = .05$; CFI = .68; RMSEA = .06). However, as mother anxiety was not associated with any other variable in these initial results, the model was rerun excluding mother anxiety. The model without mother anxiety had a good fit to the data ($x^2(1) = .29$, $p = .59$; CFI = 1; RMSEA = 0). For this model, a stability effect of parental control was seen ($\beta = .12$, $p = .02$), as well as a significant effect of child attentional control on child ADHD symptoms ($\beta = -.16$, $p = .02$). No other significant effects were seen.

The models were then rerun to control for child IQ. The model fit was again better when mother anxiety was removed from the model (before removing mother anxiety: $x^2(3) = 10.4$, $p = .02$; CFI = .40; RMSEA = .08; after removing mother anxiety: $x^2(1) = .24$, $p = .62$; CFI = 1; RMSEA = 0). For this final model, controlling for child IQ, the only significant path was the path representing the stability of parental control over time ($\beta = .13$, $p < .05$). A trending effect of child attentional control at 8-years on child ADHD symptoms at 13-years was seen ($\beta = -.13$, $p = .06$). The final model is presented with standardised beta coefficients in Figure 12.
Model 2: Parental control with parent-to-child hostility. For the model including parental control at 5-years and parent-to-child hostility at 12.5-years, poor model fit was seen for the proposed model ($x^2(3) = 7.42, p = .06; \text{CFI} = .69; \text{RMSEA} = .06$). As before, good model fit was seen when mother anxiety was removed from the model ($x^2(1) = .44, p = .51; \text{CFI} = 1; \text{RMSEA} = 0$). There was a significant effect of child attentional control on later child ADHD symptoms ($\beta = -.16, p = .02$). Trending effects of child inhibitory control on parent-to-child hostility ($\beta = -.10, p = .09$) and of parent-to-child hostility on child ADHD symptoms ($\beta = .13, p = .07$) were seen. No other significant effects were found.

When the model was rerun controlling for child IQ, model fit was good when mother anxiety was removed (before removing mother anxiety: $x^2(3) = 9.59, p = .02; \text{CFI} = .53; \text{RMSEA} = .07$; after removing mother anxiety: $x^2(1) = .39, p = .53; \text{CFI} = 1; \text{RMSEA} = 0$). For this final model no significant paths were found, but trending effects of child attentional control on later child ADHD symptoms ($\beta = -.13, p = .06$), of child inhibitory control on parent-to-child hostility ($\beta = -.11, p = .06$), and of parent-to-child
hostility on child ADHD symptoms ($\beta = .12$, $p = .06$) were seen. The final model is presented with standardised beta coefficients in Figure 13.

![Cascade model with standardized coefficients.](Image)

**Figure 13.** Cascade model with standardized coefficients.

†$p < .10$

**Model 3: Scaffolding with parental control.** For the model including scaffolding behaviours at 5-years and parental control at 12.5 years, poor model fit was initially produced ($x^2(3) = 7.87$, $p = .05$; CFI = .60; RMSEA = .06). Again, the model fit was good when mother anxiety was removed from the model ($x^2(1) = .07$, $p = .79$; CFI = 1; RMSEA = 0). For this model, child attentional control was significantly associated with later child ADHD symptoms ($\beta = -.16$, $p = .02$). No other significant effects were seen for this model.

When child IQ was controlled for, the model fit was again better without the inclusion of mother anxiety (before mother anxiety removed: $x^2(3) = 10.49$, $p = .01$; CFI = .30; RMSEA = .08; after mother anxiety removed: $x^2(1) = .004$, $p = .95$; CFI = 1; RMSEA = 0). No significant paths were found, but a trending effect of child attentional
control at 8-years on later child ADHD symptoms was seen ($\beta = -.13$, $p = .06$). The final model is presented with standardised beta coefficients in Figure 14.

![Cascade model with standardized coefficients.](image)

**Figure 14.** Cascade model with standardized coefficients.

†$p < .10$

**Model 4: Scaffolding with parent-to-child hostility.** For the model including parental scaffolding behaviours at 5-years and parent-to-child hostility at 12.5-years, poor model fit was seen at first ($x^2(3) = 7.03$, $p = .07$; CFI = .74; RMSEA = .06). After the removal of mother anxiety from the model, the model fit showed a good fit to the data ($x^2(1) = .09$, $p = .76$; CFI = 1; RMSEA = 0). For this model, an effect of child attentional control on later child ADHD symptoms was found ($\beta = -.16$, $p = .02$). Two trending effects of child inhibitory control on parent-to-child hostility ($\beta = -.10$, $p = .09$) and parent-to-child hostility on child ADHD symptoms ($\beta = .13$, $p = .07$) were also seen.

When the model was rerun to control for child IQ, the model fit was again better when mother anxiety was removed from the model (before removing mother anxiety: $x^2(3) = 9.18$, $p = .03$; CFI = .60; RMSEA = .07; after removing mother anxiety: $x^2(1) = .09$, $p = .76$; CFI = 1; RMSEA = 0).
For this final model, a significant effect of child inhibitory control on parent-to-child hostility emerged ($\beta = -0.12, p < .05$), the path from child attentional control to child ADHD symptoms was reduced to a trending effect ($\beta = -0.13, p = 0.06$), and the trending effect of parent-to-child hostility on child ADHD symptoms remained ($\beta = 0.12, p = 0.06$). The final model is presented with standardised beta coefficients in Figure 15.

![Cascade model with standardized coefficients](image)

**Figure 15.** Cascade model with standardized coefficients.

†$p < .10$; *$p < .05$

No significant gender differences were observed for any of the models.

**Discussion**

The current study aimed to examine parental predictors of child attentional and inhibitory control and parenting behaviours that may be predicted in turn by these child attributes. The study further aimed to explore how child attentional and inhibitory control and parenting behaviours all relate to ADHD symptoms over time.

Neither parental scaffolding nor parental control, as observed at 5-years, predicted either child attentional control at 8-years or inhibitory control at 10-years in
the current sample. Despite the lack of evidence in the current analyses for the influence of parenting behaviours on the development of child effortful control, previous research has revealed the importance of parenting and the home environment for the development of such abilities in children (Bridgett, Burt, & Edwards, 2015; Kopp, 1982). In particular, evidence has previously highlighted parental scaffolding as beneficial for the development of child effortful control (Lengua et al., 2007) and overcontrolling parenting as detrimental to child self-regulation development (Karreman et al., 2008; Roskam, Stievenart, Meunier, & Noël, 2014). The difference in results between previous studies and the current analysis may potentially be due to the age at which these child abilities were assessed. There is evidence that child inhibitory and attentional control start to develop in toddlerhood (Hongwanishkul, Happaney, Lee, & Zelazo, 2005; Nigg, 2017). It is possible, considering evidence of parent-to-child effects during these preschool years (e.g. Cecil et al., 2012; Eisenberg et al., 2015; Heatly & Votruba-Drzal, 2017), that an effect would have been found if it had been possible to test this relationship during this earlier stage of development. The difference may also be related to the longitudinal design of the current study; perhaps parenting behaviours are important for the development of such abilities, but opportunities at school help children to develop these abilities and allow catch-up for children who start school with a deficit in these effortful control skills. The influence of school-based interventions on child self-regulation has previously been noted (Dignath, Buettner, & Langfeldt, 2008). At the age the children completed the attentional control and inhibitory control tasks they had already spent several years in the school system. More research would need to examine whether parenting influence is merely short-term for the development of child effortful control.
The methodology used for the current study might also account for the lack of significant effects found in the current analyses. The role that methodology plays in determining whether a significant effect (by traditional null hypothesis significance testing) is found has been highlighted in the systematic review that is reported in the current thesis. The relationship between parenting behaviours and child effortful control may be stronger if questionnaires are used as opposed to laboratory-based (lab) tasks and observational methods such as in the current study. Until pre-registration of study aims becomes standard practice in this field, it is not possible to know whether the lack of association between parenting behaviours and later child attentional and inhibitory control in the current study is an uncommon finding or whether this could have been expected given the choice of methodology. Unfortunately, due to publication bias skewing our view of previous research findings, it is not possible to know with certainty whether the lack of evidence for parent-to-child effects in the current analyses were due to the methodology alone, with previous findings of parent-to-child effects being exaggerated by shared method variance. It could be that observational methods and lab tasks capture slightly different constructs to questionnaires. Indeed, relationships between questionnaires and lab tasks aiming to tap into executive functioning abilities are not found consistently across the literature (Chaytor, Schmitter-Edgecombe, & Burr, 2006).

Although neither child attentional nor inhibitory control predicted later parental control, there was some, albeit modest, evidence that child inhibitory control did predict later parent-to-child hostility. This finding supports previous literature suggesting that challenging child attributes can evoke hostile reactions from parents (Lifford, Harold, & Thapar, 2009; Harold et al., 2013; Buck, 2014). In particular, poor child inhibitory control has previously been shown to evoke parenting behaviours (Merz et al., 2017).
and combined child effortful control measures have been specifically linked to levels of hostile parenting (Heatly & Votruba-Drzal, 2017; Lee, Zhou, Eisenberg, & Wang, 2013). The finding that child inhibitory control is associated with later parent-to-child hostility highlights the importance of providing parents of children at increased risk for developing poorer inhibitory control with coping strategies that could reduce the likelihood of hostile reactions being evoked during challenging interactions with the child. Improving child inhibitory control could increase both parent and child wellbeing.

It’s important to highlight that in the current analyses child attentional and inhibitory control were not significantly associated with one another and these abilities were differentially related to other variables; only inhibitory control was associated with any later parenting behaviours and only attentional control, but not inhibitory control, had an association with later child ADHD symptoms. Interventions aimed at the reduction of early attentional control difficulties may prove to be useful in the prevention or alleviation of child ADHD symptoms. Future research using different measures to capture attentional and inhibitory control at these time-points would be required before concluding that attentional control may be a better indicator of later risk for ADHD symptoms than inhibitory control. However, before the influence of child IQ was taken into consideration, child attentional control was repeatedly associated with child ADHD symptoms across all models. It may be, then, that part of this previously established association is not specific to attentional control abilities, but are partly accounted for by general cognitive ability. Again, further research would be required to fully explore the relationship between earlier child attentional control and later child ADHD symptoms whilst taking into account other cognitive abilities, before concluding that this relationship is due to child IQ. However, the importance of taking child IQ into account when examining child attentional and inhibitory control is clear given that the
findings of all models presented in the current analyses changed depending on whether child IQ was controlled for or not. It is thus important for researchers to be open and clear about whether analyses have controlled for potential confounding variables or not.

The finding that only child inhibitory control, and not attentional control, was associated with later parent-to-child hostility could have partly been due to the age at which child inhibitory control was measured being closer to the age at which parenting was measured than for attentional control. However, this reasoning would not explain why attentional control would be more closely associated with ADHD symptoms than inhibitory control. Instead, it seems likely that these abilities independently predict different outcomes. Attentional and inhibitory control, even when assessed separately, are often grouped together as one single effortful control factor, and these findings suggest that perhaps greater insight from future research could be gained from separating these abilities and examining their individual predictors and consequences.

It is crucial to highlight here that the effect sizes and p-values of the trending associations and ‘significant’ paths in the final model were very similar, and whether a path was ‘significant’ or not changed based on whether child IQ was controlled for. Although the current paper does not aim to discuss in full whether traditional null hypothesis testing methods should be completely abandoned, the suggestion that evidence is provided in this paper for a child-to-parent effect, but not for earlier child and parent influences on later child ADHD symptoms should be avoided. Instead, weak evidence is provided for all trending and ‘significant’ paths in the models presented in the current analyses. This weak evidence suggests that further research using larger samples or different measures would be helpful for further exploration into relationships between parenting behaviours, child inhibitory and attentional control development, and child ADHD symptoms.
Limitations and Future Research Directions

As previously noted, it is possible that the age at which child attentional and inhibitory control were measured had an impact on the findings reported here. Specifically, parent-to-child effects may have been more likely to be found if these child abilities were assessed before the child started formal education. As the school environment can have a great influence on the development of these abilities (Dignath, Buettner, & Langfeldt, 2008), less variance would be explained by parenting behaviours after the child starts school. It may be that by ages 8- and 10-years that it is too late to clearly investigate parental predictors of effortful control, and future research should investigate whether a parent-to-child effect is evident earlier in childhood.

Unfortunately, due to availability of the measures in the current study, a cross-lagged design could not be applied to test for a direction of effects between parenting behaviours and child attentional or inhibitory control. Without being able to examine parenting behaviours and child attributes simultaneously over at least two time-points, it is not possible to determine a direction of effects between parent and child behaviours, and only weak evidence can be presented for an evocative effect. Future research will need to use a cross-lagged design in order to explicitly test the direction of effects between parenting behaviours and child attentional and inhibitory control. Ideally, future research should use more than two time-points, in order to examine whether this relationship changes over time. The use of more than two time-points allows researchers to test whether relationships change depending on the developmental age at which the child or parent is being assessed (Serbin et al., 2015).

Finally, the association found in the current study between child inhibitory control and parent-to-child hostility may have been due to shared genes between the
child and parent. If genes associated with poorer self-regulation were increasing the likelihood of both children having difficulties inhibiting unhelpful behaviours and parents struggling to hold back hostile reactions to challenging child behaviours, then this link would be a genetic one and not evidence of an environmental child-to-parent effect. Without repeating the study using a genetically sensitive sample, it is not possible to determine whether this child-to-parent effect is truly an environmental effect. Again, future research needs to utilise genetically sensitive designs to explore parent-child associations with greater clarity.

Conclusions

The current study used a longitudinal research design to test parenting predictors of child attentional and inhibitory control, and parenting behaviours elicited by these abilities, or lack of. Although parenting behaviours were not seen to predict the development of child attentional or inhibitory control in the current study, poorer child inhibitory control was modestly associated with later parent-to-child hostility. The findings from the current study suggest that child effortful control can influence parenting behaviours and that research needs to consider the potential for child-to-parent effects when examining factors involved in child and family wellbeing. It is also possible that child attentional control is a better indicator of later risk for the development of ADHD symptoms than child inhibitory control, but this effect may be explained by general cognitive ability. The influence of methodology choice, age at testing, and testing associations longitudinally for effects over time on effect sizes can be seen through the low estimates returned in these analyses. Thus, future research needs to be open about implications of methodology choices made in order to promote good scientific practice.
Chapter 5:

General Discussion

What This Thesis Set Out to Explore

The intended aim of this thesis was to explore developmental pathways to child ADHD development and associated academic difficulties, such as poorer maths performance. The research was particularly intended to focus on the importance of parenting behaviours and early child temperamental traits, such as effortful control and trait impulsivity. These research aims were developed due to the acknowledgement that child ADHD symptoms can have severe and long-term consequences in family, academic, and social domains (Ingram, Hechtman, & Morgenstern, 1999). In particular, childhood ADHD symptoms have been repeatedly associated with difficulties at school (Gilmore et al., 2013; Kim, Nordling, Yoon, Boldt, & Kochanska, 2013; Rimm-Kaufman, Curby, Grimm, Nathanson, & Brock, 2009). By understanding the developmental pathways to ADHD symptom development and maintenance, we can gain a clearer picture of what kind of interventions would be most helpful for the deterrence or reduction of symptoms, when to implement such interventions, and which families would most benefit from intervention. By informing interventions aimed at reducing either ADHD symptoms directly or risk factors associated with later development of ADHD symptoms, the consequences of ADHD symptoms may be avoided or reduced. Developmental cascade models allow us to explore predictors of psychopathology over time, whilst also examining the wider context of knock-on effects involved in the development of child psychopathology. Thus, it was decided to test developmental cascade models to tackle the proposed research questions.
After establishing the importance of child effortful control for the development of child ADHD symptoms in chapter 2, as well as the possibility of both parent-to-child effects and evocative child-to-parent effects, the focus then narrowed to the importance of bidirectional parent-child effects involved in the development of child effortful control, and how these might play a role in the later development of ADHD symptoms. The aim of the following systematic review (chapter 3) was to get an overview of what had already been established by researchers examining the importance of child effortful control for the production of later parenting behaviours. This systematic review further aimed to clarify when a child-to-parent effect would or would not be found, examining whether these effects are only present at particular ages or for particular parenting behaviours, and also examining whether particular research designs are associated with an increased or decreased likelihood of finding evidence for an effect. Once the possibility of a child-to-parent effect from child effortful control to parenting behaviours was established in this review, the final analyses for this thesis (chapter 4) then aimed to explore this potential bidirectional relationship between child effortful control and parenting behaviours, and their association with later child ADHD symptoms, in greater depth.

**What the Findings Revealed**

**Evidence for parent-to-child effects.** Firstly, the findings from the first set of analyses with the adoption-at-birth (EGDS) sample (chapter 2) highlighted the importance of parenting behaviours for child self-regulation, specifically ADHD symptoms. These findings were robust even whilst accounting for previous child symptoms and using a sample that removed the confound of shared genes between the child and parent that is present in traditional family study designs; by using this genetically sensitive sample it was possible to test for a ‘pure’ parenting effect, which
must be an environmental effect. What the current research using the adoption-at-birth (EGDS) sample was able to do, but that had not previously been explored, was to test for a direction of effects between parenting (parent-to-child hostility) and child ADHD. Through testing this direction of effects between child ages 6- and 7-years, a clear direction of effects was found from parent-to-child hostility to child ADHD symptoms.

Less evidence for the importance of parenting behaviours for child self-regulatory development was seen, however, using the UK (ALSPAC) sample. It is possible that this difference in findings between these samples was in part due to the age at which child effortful control was measured. The relationship between parenting behaviours and child self-regulatory abilities may change in strength or nature across development. It is also possible that the difference in findings was due to how parenting was measured. Although both of these chapters did explore the relationship between parent-to-child hostility and later child ADHD symptoms, the analyses using the EGDS sample (chapter 2) utilised parent self-reports of their parenting behaviours, whereas the parenting measure in the ALSPAC sample was observational. On one hand, parents in an observational task may not display the same frequency and level of hostility towards the child compared to when the dyad are not being observed; parents’ own self-reports may pick up on everyday encounters. However, it is also possible that parents may be less willing to rate themselves as being hostile towards their child than an observer is. It is also possible that the association between parent-to-child hostility and parent-reported child ADHD symptoms in the EGDS analyses were partly due to shared method variance, with parents who feel that they are struggling to cope with their child’s symptoms exaggerating both reports of their own parenting responses and their child’s symptoms.
It is notable that the systematic review presented in chapter 3 indicates that it is common when studies use questionnaires to measure both child and parent attributes to be more likely to find ‘significant’ associations between these child and parent variables. It is also important that, although ‘significant’ effects between parent-to-child hostility and child ADHD symptoms were not found using the ALSPAC sample, the effect sizes for this path were similar for the ALSPAC and EGDS analyses. Taking this into consideration, it seems that there is evidence for a parent-to-child effect of hostility on child ADHD symptoms, but that this effect is not necessarily a strong one and cannot explain a large proportion of variance in child ADHD symptoms. However, if both samples found roughly the same effect size for this path, the ALSPAC analyses act as a replication of the role of parenting for child ADHD symptom development, even if these parenting behaviours are not wholly causal and parent-to-child hostility is just one factor that can increase the likelihood of child ADHD symptoms being reported, but that isn’t a requirement for development of such symptoms. It is likely that negative parenting behaviours do influence child psychopathology risk, but not all children with increased psychopathology come from families where parents display greater negative behaviours towards the child. Low effect sizes, then, should be expected between parenting behaviours and child psychopathology. Belsky (1997) suggests that effect sizes of parenting effects are often lower than expected for parenting studies because of differential susceptibility; some children are more influenced by parenting behaviours than others. Perhaps larger effect sizes could be seen if greater and lower genetic risk groups were identified; if differential susceptibility is evident, for lower genetic risk groups it would be unlikely to find a significant parenting effect, but for higher genetic risk groups you would expect a much larger parenting effect. Identifying high and low genetic risk groups would also identify the families that would benefit most from
parenting interventions. There are multiple pathways through which children can develop psychopathologies, such as ADHD, and finding even weak associations between these attributes, especially within a genetically sensitive sample and controlling for previous child symptoms, highlights the importance of the home environment and parenting behaviours.

**Evidence for child-to-parent effects.** As well as reinforcing the literature base on the importance of parenting behaviours for child self-regulatory outcomes, evidence has been presented throughout this thesis for the presence of child-to-parent effects. In the initial set of analyses presented in chapter 2 of this thesis (EGDS sample), child effortful control at age 4.5-years predicted parent-to-child hostility approximately 18 months later. The systematic review presented in chapter 3 found that the majority of published papers examining the effect of child effortful control on later parenting behaviours reported a ‘significant’ effect. Finally, mixed evidence was produced for child-to-parent effects in chapter 4 (ALSPAC sample); one out of four of the models found evidence for a child-to-parent effect, with child inhibitory control predicting parent-to-child hostility, but only when the model controlled for child IQ. Overall, these results indicate that in some circumstances child effortful control, or more often poor effortful control, can influence parenting behaviours. The findings from the systematic review and analyses with the ALSPAC sample particularly highlight that finding a child-to-parent effect is dependent on which parenting behaviours are being examined, and even what other variables are being controlled for in the model.

This finding that the nature of the relationship between child and parent attributes may change depending on which parenting behaviour or style is being examined can be seen for the self-regulation of behaviour, emotions, and cognition in adolescence too (Moilanen, Rasmussen, & Padilla-Walker, 2015). The finding that
children have an influence on parents’ behaviours explains the observation that parents behave differently with each of their children; parents respond to their children’s individual needs, and thus some child-to-parent effects represent parental sensitivity and attunement to their child’s needs (Kowal & Kramer, 1997). Although child-to-parent effects can be positive for the child and the child-parent relationship, it seems from the findings of the systematic review in chapter 3 that the relationship between child effortful control and later parenting behaviours most often represents a negative reaction to poorer child effortful control. Equally, previously research has suggested that negative child characteristics are more likely to elicit a parenting response than positive child characteristics (Oliver, Trzaskowski, & Plomin, 2014). A previous paper using the EGDS sample revealed that whether a child-to-parent effect was found depended on the specific child and parent attributes that were being tested, as well as whether mother or father parenting was being measured (Hajal et al., 2015). Similar findings have been reported previously in regards to differences between mothers and fathers when testing for child-to-parent effects (e.g. Roskam, Stievenart, Meunier, & Noël, 2014). Another factor that may influence whether child-to-parent effects are observed or not is the methodology that is employed. The systematic review in chapter 3 found that methodology choice made a big difference to whether an effect was reported, with studies employing questionnaires to measure child effortful control, or at least the same methodology as used to measure parenting behaviours, more likely to report a child-to-parent effect than those using lab tasks to collect data. The lack of associations between parent and child factors in the analyses using the ALSPAC sample (reported in chapter 4) may have been at least partly due to the use of lab tasks to assess the components of child effortful control. Unfortunately, the opportunity to test whether greater associations would be reported if questionnaires were employed was not presented, as
The measures were not available in this dataset. It would be interesting for future research to test such differences using a similar longitudinal dataset.

**The importance of effortful control for later child outcomes.** The importance of the healthy development of child effortful control for later outcomes can be seen clearly through the finding in chapter 2 (EGDS sample) that child effortful control at child age 4.5-years predicted child ADHD symptoms at age 6-years, even whilst controlling for earlier child trait impulsivity. This association between earlier child effortful control and later ADHD symptoms has been reported repeatedly in past literature (Nigg, Goldsmith, & Sachek, 2004). What is particularly interesting, however, is that when effortful control was broken down into its main components of attentional control and inhibitory control in chapter 4, only attentional control was associated with later ADHD symptoms, and even this association dropped to a trending effect when child general cognitive ability was controlled for. The smaller associations between these components of effortful control and later ADHD symptoms seen in the analyses with the ALSPAC data may again be due to choice in methodology, with this set of analyses utilising lab task data to assess child attentional and inhibitory control, and parent-reported questionnaires to assess child ADHD symptoms. It is possible that stronger associations would have been found if child attentional and inhibitory control had also been rated via parent-report on a questionnaire. Interestingly, a previous study exploring relations between child effortful control, measured with self-report questionnaires and lab-tasks, and psychopathology (anxiety, depression, and aggression) found that questionnaire reports of effortful were associated with psychopathology, but lab-task data was not (Muris, Pennen, Sigmond, & Mayer, 2008). Although there was only weak evidence provided for links between child attentional control and later ADHD symptoms in this set of analyses, it is still of interest that variability in child
attentional control may be more closely associated with later ADHD symptoms than variability in child inhibitory control. This suggests that child attentional control in middle childhood may act as a better indicator of risk than inhibitory control for psychopathology, or at least ADHD, in adolescence, and difficulties in attentional control during childhood may indicate that the child may benefit from intervention in order to reduce the likelihood of severe symptomology later. Clearly more research using different methods to capture these constructs is required before any conclusions about the increased value of attentional control as a risk factor for ADHD symptoms can be made.

As well as influencing the development of later ADHD symptoms, child effortful control was seen to indirectly influence maths performance in chapter 2. The role of child effortful control in academic performance, and particularly for maths, is well established (Gilmore et al., 2013; Brock, Rimm-Kaufman, Nathanson, & Grimm, 2009). These findings further highlight the importance of early effortful control development for later outcomes.

Implications

**Implications for intervention efforts.** The role of early child effortful control in predicting later ADHD symptoms, that was especially highlighted in chapter 2, suggests that childhood ADHD symptoms could be reduced or prevented through early intervention efforts aimed at improving child effortful control. Childhood interventions, such as ‘Braingame Brian’, have sought to target children with symptoms of ADHD and improve symptoms by training executive functioning capabilities, such as inhibitory control (Prins et al., 2013). Given the core role of self-regulatory abilities for ADHD (Barkley, 1997; Brown, 2009), early interventions aimed at improving effortful control
or closely related self-regulatory abilities are likely to reduce ADHD symptoms both immediately and over time.

The role of parenting behaviours in predicting child outcomes, again especially highlighted in chapter 2, supports the use of parenting interventions aimed at reducing child ADHD symptoms. However, parenting interventions aimed at improving child effortful control need to emphasise that an improvement in the child’s effortful control is not likely to occur overnight. Practice makes perfect, and it is important that the child keeps working at building their self-regulatory abilities in a home environment that allows for such opportunities in order for improvement to be seen (Diamond, 2013).

The findings reported throughout this thesis highlight the observation that parents may use different parenting behaviours depending on a child’s characteristics. In some cases this may be an active attempt to improve or control poor child behaviour. In the context of poor child effortful control, a parent of a child with deficits in effortful control abilities may either punish a child for ‘acting before thinking’ or for not paying attention in order to try to deter problematic behaviour, or the parent may attempt to do more for the child, taking greater control in interactions and over daily activities (such as chores and social engagements). From the limited evidence reviewed in chapter 3 it seems likely that parents of children with poorer effortful control may be more likely to exert greater control over these children (Eisenberg et al., 2015; Hong et al., 2015; Lee et al., 2013; Padilla-Walker & Coyne, 2011; Padilla-Walker et al., 2012). However, for a child’s self-regulatory abilities to develop adequately, enough freedom and thus opportunities for practicing such regulatory abilities are required. Equally, harsh parenting is more common for parents of children with poorer effortful control (Brody & Ge, 2001; Cecil et al., 2012), yet parenting higher in emotional warmth is associated greater effortful control development (Eiden, Colder, Edwards, & Leonard, 2009; von
Interventions should therefore acknowledge the likely bidirectional relationship between child effortful control and parenting behaviours, and support parents in decreasing the amount of control and harsh parenting practices they might exert during interactions with their child so that the child’s self-regulation skills can develop, leading to a more positive parent-child relationship.

Although traditional parenting interventions or parenting education programmes might be helpful for those parents who are actively responding to their child’s poorer effortful control using increased discipline or control, many parents are likely to be reacting unintentionally to the challenging child behaviour. This reaction may be more likely if the parent also struggles with poorer self-regulatory control. Poorer self-regulation, on the part of the parent, could make responding calmly to challenging child behaviours particularly difficult. Due to shared genes between the child and parent when the dyad are biologically related, parents of children with poorer self-regulatory abilities are more likely to struggle with self-regulation themselves. Parents who have poorer self-regulatory abilities may be more likely to display less helpful parenting behaviours in response to challenging child behaviours (Deater-Deckard, Sewell, Petrill, & Thompson, 2010), such as failing to inhibit automatic responses like shouting or engaging in harsh discipline. Recent research has further indicated that parental executive functioning may be associated with how frequently the parent engages in activities with the child that promote child executive functioning development (Korucu, Litkowski, Purpura, & Schmitt, 2019). If parents with poorer effortful control provide genes associated with poorer effortful control to their child and also, due to their own difficulties with self-regulating their behaviour, provide a home environment associated with poorer effortful control development, then children of parents with poorer effortful
control are likely to also show difficulties in effortful control. Studies revealing associations between child and parent self-regulation support the claim that children of parents with poorer self-regulation are at an increased risk for developing such problems themselves (e.g. Korucu et al., 2019). Perhaps the most effective way to improve child effortful control would be to simultaneously work to improve the self-regulatory abilities of children and parents, as otherwise poor effortful control seen for the parent could maintain a home environment for the child that is associated with less healthy effortful control development. Equally, if a child’s effortful control is less developed, then more challenging behaviours may be produced, increasing levels of parenting stress (Paley, O’Connor, Frankel, & Marquardt, 2006), which then in turn may lead to undesirable parenting behaviours being produced (Anthony et al., 2005). A joint family intervention programme may be better able to stop the cycle of symptom maintenance. Conversely, by implementing interventions aimed solely at improving child effortful control, the cycle of parents and children exacerbating each other’s problems will continue after cessation of the intervention.

Family interventions, as well as aiming to improve both child and parent effortful control, could benefit from including sessions explicitly focused on how to cope and deal with challenging child behaviours. Qualitative research has previously revealed that parents engaging in parenting programmes may find advice on how to cope with challenging child behaviours and how to engage in self-care in the process particularly helpful (Harold, Hampden-Thompson, Rodic, & Sellers, 2017). Interventions helping parents to cope better with challenging child behaviour would help to both reduce parenting stress and increase positive parenting practices that in turn would lead to more adaptive child behaviours (including greater effortful control), better child mental wellbeing, and could even provide a better example of parenting and
coping skills for the child in the future when they become a parent. This would reduce the rate of intergenerational transmission of poor effortful control, mental health and associated outcomes, and parenting behaviours over generations.

As well as having implications for intervention efforts, findings suggest that the language we use in parenting advice more generally, as well as within academic contexts, needs to reflect the bidirectional nature of parent-child relations. A shift to focus on parent coping strategies, rather than simply describing ‘good parenting practices’, will not only provide the benefits noted above, but could also reduce feelings of self-blame and helplessness amongst parents with poorer self-regulation who find dealing with challenging child characteristics particularly difficult. The assumption that all parents can present or inhibit certain parenting behaviours equally easily is unhelpful, as is the assumption that parents who struggle to inhibit unhelpful behaviours are unaware that these behaviours are undesirable. Some parenting advice seems to assume that all parental behavioural choices are deliberate and this really isn’t always the case. The vast majority of parents put in a lot of time and effort trying to provide the best home environment for their children that they can, so the language used in both parenting advice and in academic writing should avoid using an accusatory tone. Instead, the literature should identify effective parental coping strategies and buffers against the increased risk that certain families may be exposed to.

Additionally, effect sizes presented across the parenting literature, especially when controlling for previous child attributes, are typically modest; this would suggest that, despite evidence for the influence of parenting on child outcomes, individual parenting behaviours cannot be considered sole ‘causes’ of child phenotypes. It seems likely, given the evidence of the reciprocal nature of child-parent effects and modest effect sizes for parenting effects, that parenting behaviours alone do not *cause* child
outcomes such as poor effortful control and ADHD symptoms. Instead, evidence of modest parenting effects suggests that the environment of those children who are at greater genetic risk for self-regulation problems can have either a positive or exacerbating effect on a child’s inherited early attributes. This idea supports the concept of differential susceptibility, suggesting that some children are at greater risk for poorer self-regulation, with a child’s genetic makeup interacting with positive or negative environments to predict particularly positive or negative outcomes. There is a possibility, then, of improving child effortful control and reducing difficulties for all family members if parents do succeed in improving their parenting skills. Although parenting behaviours are not sole causal factors in the development of child self-regulatory abilities, and not all children with poorer effortful control or ADHD symptoms have parents who show greater hostility or exertion of control, targeting interventions at families who are at risk of either poorer self-regulation or poorer parenting practices may lead to great improvement in both parent and child behaviours.

**Should we be separating out effortful control?** As noted in the general introduction (chapter 1), there are two major approaches to researching effortful control. Researchers approaching the topic from a cognitive approach typically separate out the components of attentional and inhibitory control, using lab tasks to tap into each individual construct. When researchers approach the topic from a developmental perspective, on the other hand, the use of questionnaires that measure both attentional and inhibitory control together are most common. When developmental psychologists do use lab tasks to assess effortful control, latent variables are frequently used to combine the separate components. Chapter 2 of this thesis uses a combined questionnaire measure to assess effortful control. Chapter 4 aimed to examine whether attentional control and inhibitory control had different relationships with parenting
behaviours. The results of the analyses showed that these two components had different relationships with different variables in the models, namely only attentional control predicted later ADHD symptoms (when not controlling for IQ) and only inhibitory control predicted parent-to-child hostility (when controlling for IQ). These findings may suggest that these two components of effortful control should be treated separately. However, it is possible that the methodology used played a role in these differences.

The reliability of the effortful control factor in chapter 2 was good ($\alpha = .86$). It could be, then, that if the analyses presented in chapter 4 had used parent-reported questions on child attentional and inhibitory control, more similar findings may have been seen for these two abilities, as well as a stronger association between the two components. A possible reason for the difference in associations between child attentional control and child inhibitory control may be that questionnaires tap into the everyday use of these abilities, whereas lab tasks are frequently criticized for lacking ecologically validity (Brown, 2009). The measures used to tap into attentional and inhibitory control in the analyses reported in chapter 4 are considered ‘cool’ measures of effortful control or executive functioning. ‘Hot’ measures of effortful control (or executive functioning) examine an individual’s ability to complete a set task when the failure or success of the task is associated with a salient outcome; for example, a reward may be offered for a successful performance, a punishment may be threatened for an inadequate performance, or completing the task may help the individual reach a personal goal. Conversely, ‘cool’ measures of effortful control (or executive functioning) measure an individual’s ability to complete a set task without any rewards or risks associated with completion or failure of the task. As goal-setting in real life involves benefits of completing the task set, lab-tasks such as those administered in the study described in chapter 4 may lack ecological validity. It is possible that the difference in associations
found in chapter 4 was partly due to the choice of ‘cool’ tasks, and that more similarities between the constructs would have been seen if the tasks more notably resembled everyday tasks.

Another possible reason for the differences between attentional and inhibitory control found in chapter 4 may be the age at which these constructs were tested. There is evidence that relations between these abilities may change across development (Best, Miller, & Jones, 2009). The strong association between these abilities that led to the good internal consistency of the effortful control factor at age 4-years in chapter 2 may have been age-specific, with this association having disappeared by ages 8- and 10-years in the ALSPAC sample in chapter 4.

Additionally, it may depend on the other factors of interest in the analyses conducted whether the components of effortful control should be treated as separate constructs or combined to create a unitary variable. When engaging in exploratory research, perhaps examining the abilities separately would enable the findings to be more enlightening as to which element of effortful control is associated with the factor in question. As individuals with symptoms of ADHD characteristically have difficulties with both attentional and inhibitory control, combined effortful control factors may be appropriate when testing for early effortful control as a risk marker. However, the results of chapter 4 do indicate that this may not always be the case.

In summary, whether effortful control should be studied as one multifaceted construct or whether attentional control and inhibitory control should be treated as separate (but often closely associated) constructs may depend on the measures used, the age of the sample, and the other factors of interest being tested.
Child-parent effects may change depending on how and when measured. Although age did not play a major role in predicting child-to-parent effects in the systematic review in chapter 3, the relationship between child effortful control and parenting behaviours did change depending on when these were measured. A back and forth transactional relationship was supported by the past literature, with child-to-parent effects stronger at some periods and the opposite true at other points. One previous review highlighted the importance of studying child executive functioning across development, especially during school years, as relations between components of executive functioning (i.e. child attentional and inhibitory control) and with other factors (e.g. parenting or later child outcomes) seem to change over the course of development (Best et al., 2009). As noted earlier, it may be that the difference in effects between chapters 2 and 4 was due to the age at which effortful control, parenting, or ADHD symptoms were assessed. On the one hand, testing these child cognitive abilities and observing parenting behaviours between ages 5- and 12-years is relatively late in development to test for such factors, as both parenting and child effortful control would have been influenced a lot by factors prior to these time-points. These abilities are likely to have started to develop prior to the first parent-child interaction task at age 5-years for the sample in chapter 4 (Garon, Bryson, & Smith, 2008). On the other hand, these child cognitive abilities are prone to great influence and continue to develop during these school years (Vaughn et al., 2011). There is also evidence that the relationship between child self-regulatory abilities and parenting behaviours changes across development (Ispa, Su-Russell, Palermo, & Carlo, 2017). It is likely, given this evidence, that if the same model was applied earlier in development, then different results may have been returned. It would be important, of course, to ensure that the tasks were developmentally appropriate for the ages examined.
Both chapters 3 and 4 indicate that different relationships with child effortful control are revealed depending on the parenting behaviour being examined. The systematic review found that the choice of parenting behaviour being assessed made a major difference to whether a child-to-parent effect was reported. Notably, the studies reported in this review that used more than two time-points and assessed multiple parenting behaviours found that the nature of the transactional relationship between child and parent attributes changed over time, with some parenting behaviours influencing the child more at certain times and some behaviours being influenced by the child’s effortful control more at other times. Studies using only two time-points, as previously suggested by Serbin et al. (2015), may only be seeing part of a bigger picture. Future research using longitudinal designs needs to take into account the potentially back-and-forth nature of parent-child effects.

**Limitations of the Current Research**

Although chapter 2 does contain a direction of effects analysis between parent-child hostility and child ADHD symptoms and both chapters 2 and 4 test the relationship between earlier child effortful control and later parenting behaviours (with chapter 4 also testing for parenting predictors of child effortful control), neither chapter included a direction of effects analysis between parenting behaviours and child effortful control (or components of effortful control). This was due to limitations of the datasets. Without applying a cross-lagged design and controlling for past parenting behaviours or child effortful control it is not possible to know whether an association, even if tested longitudinally, is actually indicative of either a parent-to-child or child-to-parent effect. The analyses in chapter 4 do take previous parenting behaviours into account when testing for the effects of child attentional and inhibitory control on parenting behaviours, yet without modelling a parent-to-child effect between the same time-points, it is not
possible to determine a direction of effects. Furthermore, only one path model in chapter 4 was able to examine the same parenting behaviour at both parenting time-points. I urge future researchers establishing longitudinal studies of development to consider the value of assessing both child and parent attributes simultaneously several times across development.

Chapters 2 and 4 focused on the development of ADHD symptoms and not on diagnosis. It is possible that different pathways may be found to be important in the prediction of a child’s diagnosis of ADHD, yet we considered it important to focus on symptomology rather than diagnosis in the current study for several reasons. Firstly, it is possible that children may present ADHD symptoms without parents or teachers acknowledging that these are symptoms of ADHD, hence not seeking a clinical diagnosis (Lewandowski, Lovett, Codding, & Gordon, 2008). Secondly, by examining ADHD symptomology on a scale, rather than approaching ADHD as a categorical diagnosis or non-diagnosis variable, it is possible to explore the association between family factors and effortful control with ADHD symptoms fully. If these associations occur as a dose-response relationship, by examining symptomology rather than diagnoses we may see the extent of associations that may not be so apparent when looking at clinical samples only (Fried, 2015). Furthermore, by exploring associations between ADHD symptoms and child and parent attributes across an entire sample, the sample size is not further restricted by the limited number of children and parents in each study with formal diagnoses of ADHD. Our choice to use symptomology rather than diagnosis has allowed for a more detailed picture of processes involved in ADHD symptom development and the impact of ADHD symptoms on family and academic outcomes.
The research contained within this thesis focused on developmental pathways to combined ADHD symptoms, and did not separate ADHD symptoms into hyperactive/impulsive or inattentive subtypes. It is possible that different results may have been found if subtypes of ADHD, instead of combined symptoms, had been modelled. It has been found, for example, that inhibitory control may be more closely associated with symptoms of inattention than of hyperactivity/impulsivity (Wåhlstedt, Thorell, & Bohlin, 2009). Moreover, it may not only be inhibitory control that is related to inattentive symptoms alone. Several studies have found that inattentive symptoms, but not hyperactive/impulsive symptoms, predict an overall executive functioning deficit for child and adolescent samples (Martel, Nikolas, & Nigg, 2007; Thorell, 2007). Further research has additionally found that the two subtypes of ADHD may map onto different consequences. Within the school setting, inattentive symptoms have been associated with poorer academic achievement (Greven, Harlaar, Dale, & Plomin, 2011; Massetti et al., 2008; Rogers, Hwang, Toplak, Weiss, & Tannock, 2011). Whereas, symptoms of impulsivity/hyperactivity may instead be more closely related to discipline problems (Barkley, Fischer, Edelbrock, & Smallish, 1990; Milich, Balentine, & Lynam, 2001). When Lahey and colleagues (1998) considered both subtypes in the same model, it was similarly found that symptoms of inattention were associated with difficulties in maths and hyperactivity/impulsivity was associated with disruptive behaviour. Future research may benefit from breaking these symptoms down to explore both predictors and consequences of particular ADHD symptoms.

All research designs used to model developmental cascades and explore family influences have strengths and weaknesses. The designs employed by the research included in this thesis are no exception. The adoption-at-birth study (EGDS) employed in chapter 2 has the advantage over the ALSPAC study employed in chapter 4 of being
able to separate genetic and environmental family influences. Where the parent-to-child effect found in chapter 2 can be attributed to an environmental parenting effect, the analyses in chapter 4 cannot boast such sureties. It is possible that the effect of child inhibitory control on parent-to-child hostility was simply due to shared genes between the dyad. If gene variants related to poor self-regulation were passed down from the parent to the child, then parenting that resembles a loss of self-control (i.e. hostile reactions) may be seen alongside a child’s own poorer self-regulatory abilities (i.e. poor inhibitory control). Without replicating this analysis using a genetically sensitive design it would not be possible to know for sure whether there really was a child-to-parent effect. Alternatively, the ALSPAC sample is a general population sample that is reasonably representative of the UK population (although the study team do note that the area that the study was based in is a slightly more affluent area than average for the UK). A limitation of adoption studies is that they can be less representative of the general population, with families typically providing more positive environments (Castle, Beckett, Rutter, & Sonuga-Barke, 2010; Natsuaki et al., 2019) and having a higher household income (Leve et al., 2007). Rates of ADHD amongst children are also more notable for adopted children (Simmel, Brooks, Barth, & Hinshaw, 2001). If parents show less variability in their parenting behaviours and children are more likely to display ADHD symptoms than average it can be difficult to generalise findings from analyses with adoption-at-birth designs. Each of these different research designs used in the current thesis has a strength that acts as the limitation of the other. By considering the findings from both sets of analyses together we can get a more accurate picture of the importance of family dynamics in child effortful control development. However, it is still prudent to keep in mind the limitations of each study when findings are reflected upon.
Recommendations for Future Research Directions and Practice in Field

Methodology choice. The difference in findings between analyses presented in chapters 2 and 4 prompted much consideration into the reasons why such a discrepancy might occur. One explanation proffered for the overall lack of parent-child associations in chapter 4 was that questionnaires, observational methods, and lab-tasks may measure slightly different constructs. The findings from the review presented in chapter 3 support this assertion, as it is more common for parent-child associations to be found for studies using questionnaire methods. Whereas observational and lab based tasks may both examine child or family functioning at one particular moment, questionnaires may be more closely related to perception of functioning (in this case parenting or child effortful control) than actual functioning. Both constructs are important to research, but it is important to acknowledge the implications that are associated with the differences in methodology. The results of chapter 2 perhaps more accurately suggest that how challenging a parent perceives their child’s behaviours to be (operationalised here by child effortful control) is associated with how much hostility they consider themselves to show towards their child, which in turn predicts how many symptoms of ADHD the parent considers the child to display later in development. Although parental perceptions of how challenging they consider their child’s behaviours and how this relates to how they perceive their own parenting behaviours is a perfectly valid research question, there may be a distinction between this and actual behaviours or difficulties. Equally, the results of chapter 4 suggest that when children struggle with inhibiting previously learned behaviours, parents may appear to show more hostile reactions when they’re interacting in public, trying to complete a task together. Despite observational or lab-task data seeming a more objective approach to measuring constructs, these methodologies have their own limitations. Due to the difficulties recruiting participants
for observational studies, it may be that adequate sample sizes are not being recruited for complex modelling, resulting in fewer significant findings as standard for such methods. Furthermore, what one group of researchers considers to be ‘warmth’ or ‘hostility’, for example, may differ from other research groups. Inter-coder reliability is not the same as validity. Moreover, being observed completing a task has been associated with a change in performance (Yantz & McCaffrey, 2009), and traditional lab-tasks show poorer ecological validity than questionnaires (Brown, 2009; Chaytor, Schmitter-Edgecombe, & Burr, 2006). Although there is some evidence that ecological validity can be improved for lab-tasks if the tasks are adapted appropriately (Chaytor et al., 2006). When deciding which methodology to use to measure parenting or child effortful control, it is important to consider the strengths and limitations of each method as well as what construct is truly being measured.

A number of innovative research designs have been proposed by developmental psychologists to attempt to avoid the limitations of the traditional methods described above. One recently proposed method to assess parenting behaviours is via wearable recording devices worn by the child. The Language Environment Analysis (LENA) system (LENA Research Foundation, 2012) was designed to assess the language that children are exposed to in their home environments, but has since been applied to assess positive and critical parenting behaviours (d’Apice, Latham, & von Stumm, 2019). These devices were worn by the child for between 5 and 16 hours per day across three days. Across these days several five-minute recordings were made that were then coded for relevant parenting behaviours. As the parents were not aware exactly when the recordings were going to be taken, and the devices were not clearly visible to the parent in the same way as a camera or interviewer would be, a more naturalistic ‘observation’ of parenting could be made with the use of these devices. Perhaps qualitative research
into how often the parents remembered thinking about the devices and their own
behaviour, as well as whether they felt those days were particularly typical in terms of
interactions, would be helpful to determine how effective this method could be as an
alternative to traditional observation tasks or questionnaires.

**Statistical inferences and open science practices.** It has been long debated
whether we should abandon traditional null hypothesis testing methods and adopt a
more stringent approach to evidence testing (Sterne & Davey Smith, 2001). Applying
traditional significance testing methods to the results of chapter 4 would lead to the
conclusion that this chapter provides evidence for the effect of child inhibitory control
on later parent-to-child hostility, and yet would also conclude that this chapter fails to
find evidence for the effect of child attentional control and parent-to-child hostility on
later child ADHD symptoms (if looking at models after controlling for child IQ).
Clearly an arbitrary cut-off point, as used in traditional hypothesis testing, is unhelpful
here if used on its own. Perhaps it would be more helpful, especially in cases when a
significance value is so close (either side) to the defined acceptance value, if greater
focus was given to the effect size. The effect size for the path from child inhibitory
control to parent-to-child hostility in the final model is modest ($\beta = -.12$). The modest
effect size here indicates weak evidence for an effect and implies that child inhibitory
control is not the sole factor explaining parenting. However, it would not be expected
that this one child attribute would be the sole, or even greatest, influence on parent-to-
child hostility. Several factors are likely to play a role in predicting the level of hostility
shown by a parent to their child. It would be expected that, due to the natural study
design of developmental cascade models not being able to control for other factors in
the way that experimental studies can, effect sizes can be much smaller than those from
experimental studies. Perhaps for a longitudinal developmental cascade model any paths
with effect sizes ($\beta$) reaching even .1 is adequate evidence of a small effect. If effect sizes are lower for correlational studies than experimental studies, then this could help to explain why relationships between child and parent attributes are not found consistently across all studies. The replication crisis in psychology has been well documented (Lilienfeld, 2017; Shrout & Rodgers, 2018), and one recommendation has been to use larger sample sizes to ensure adequate power to run analyses (Shrout & Rodgers, 2018). It is possible that had the entire ALSPAC sample participated in the parent-child interaction tasks and effortful control lab-tasks used for the current study that more paths would have reached traditional significance levels; sample size certainly played the greatest role in determining whether a child-to-parent effect was found in the systematic review presented in chapter 3. Future research should aim to use larger samples, or at least be careful not to apply complex statistical models to data from smaller samples.

Perhaps it should become commonplace for researchers to avoid referring to ‘statistical significance’ and instead refer to the strength of the evidence provided. By referring to how strong evidence is, researchers could factor in other study design qualities, such as how representative the sample is or if the results are in line with or against results presented in previous papers. Another solution would be to adopt Bayesian statistics, as this method allows the null hypothesis to be tested, meaning that a difference between there being not enough evidence for an effect and evidence that this is no effect can be established. This statistical technique would deter the rate of both type 1 and type 2 errors. In other words, researchers would be less prone to falsely concluding that study results prove or disprove theories when analyses only provide weak evidence of an effect, or alternatively closely miss reaching significance thresholds. By shifting to a system where we test both null and experimental
hypotheses, we can gain a greater understanding of whether results indicate evidence of effects, lack of effects, or whether there is just not enough evidence for an effect. This move would mean that we would not assume that a non-significant effect means no effect: a common error in scientific writing. The effect sizes in chapter 4 for the parent-to-child effects were very low, but without such statistical tests it is not possible to know whether this indicates a lack of evidence or actually a lack of effect at these ages. Certainly, just missing or reaching traditional significance thresholds does not constitute robust evidence for either the presence or absence of an effect, and was never intended to (Sterne & Davey Smith, 2001). Being able to tell with greater certainty whether a study finds evidence of no effect or simply hasn’t provided evidence for an effect would help with understanding whether we need more research with larger samples or if we need to accept a lack of effect and move on to different research question. This is essential for the progression of science. This would also help to reduce publication bias. Currently papers detailing a lack of effect are rarely published; however, if the study had found evidence for the null hypothesis then this is more clearly adding to our understanding of the topic, and may be more likely to get published. To encourage better science, we need to promote open science. The focus should be on trying to understand what is true, rather than on trying to get a positive result. To reduce ‘p-hacking’ in science we need to either convince journals to accept more papers with negative results, or as standard regularly update our research profiles about what we are currently working on, updating these once results are either published or the decision has been made (either by the authors or journals submitting to) that the findings won’t be presented elsewhere. This would be an easy way to promote open science and boost understanding and progress in the field; it could also mean that far less resources would be wasted investigating something that has been repeatedly found to not work or show
null results by researchers not publishing said results. The idea of pre-registering research plans has been previously suggested as an efficient way of promoting better quality science (e.g. Shrout & Rodgers, 2018). By pre-registering analysis plans on our own research profiles, it would be far more likely that other researchers in the field would access the results and learn from them if no paper is published from the analyses than if pre-registration occurred away from social media.

A move to both more open science and away from traditional hypothesis testing would mean that the criteria for good quality science and appropriate size samples would also become clearer, and science could move to a point where less time and money would be wasted using inadequate designs to test complex models. Sample size plays a big role in whether evidence for effects is found, with this being the biggest predictor of whether child-to-parent effects were found for studies presented in chapter 3. The use of such statistics would help to develop our understanding of statistics and how to interpret findings.

**How parenting research could benefit from behavioural genetics.** Although genetics has moved on from looking at the impact of individual gene variants to a genome-wide approach, there’s no clear consensus on how to simultaneously explore the impacts of a large number of observational codes used to assess parenting styles. Sometimes latent or combined variables are formed from a few observational codes, but this only covers a few precise parenting behaviours. Concluding that parenting does not have an impact on child effortful control development between the ages of 5-years and 10-years as a consequence of examining the results of chapter 4, for example, would be unhelpful. Just as genome-wide association studies have been developed from the knowledge that one genetic variant alone is unlikely to have a significant effect on a behavioural outcome, one specific parenting behaviour on its own is also unlikely to
have a major effect on a child outcome (unless the parenting behaviour is extreme), and vice versa. Instead, just as with gene variants, a number of parenting behaviours may act together to increase the likelihood of a child outcome being observed. Perhaps one of the reasons that questionnaire studies tend to find more significant parenting effects than observational studies is that questionnaires can pick up on a broader construct than individual observational codes do. If a statistical and/or methodological technique could be developed that would examine the impact of a large number of parenting behaviours, it could help to advance our knowledge of parenting influences on child development and avoid type 2 errors.

Future research further needs to use genetically sensitive designs to explore a possible bidirectional relationship between parenting and child effortful control. The one paper that did use an adoption design in the systematic review (chapter 3) found different findings compared to the other papers included in the review. Research into possible gene-environment interplay could help us to understand how parents may be affected by a combination of their own genes and their child’s behaviour.

**Summary of Research Contributions**

The research included in this thesis used longitudinal datasets to test how parents and children can have an impact on one another, specifically testing how this relates to the development of child effortful control, ADHD symptoms, and later academic outcomes. Chapter 2 used a genetically sensitive adoption-at-birth design to test the direction of effects between parent-to-child hostility and child ADHD symptoms. This chapter then applied these findings, and the findings of a direction of effects analysis between child effortful control and trait impulsivity, to a developmental cascade model of child ADHD development and associated maths outcomes. Chapter 3
then explored the extent to which child effortful control could impact parenting behaviours, by systematically reviewing the literature and considering whether certain sample or study characteristics had an influence on these results. Finally, chapter 4 examined whether child attentional and inhibitory control are predicted by or predictive of different parenting behaviours to one another. This set of analyses further examined whether controlling for child general cognitive ability can impact findings. The analyses presented in chapter 2 and 4 used different methodologies and found support for the assertion of chapter 3 that choice in methodology can have a big influence over the effect sizes returned. Together, the findings presented suggest that at certain ages parenting can play an important role in the development of child self-regulatory outcomes (specifically ADHD symptoms), but that several factors may determine whether parenting effects are found. Similarly, these chapters present evidence for the impact of child effortful control on parenting behaviours, but modest effect sizes might indicate that this child attribute is not the sole determinant of parenting behaviours.

Conclusions

Both the evidence base reviewed and the analyses of chapter 2 of this thesis highlight the importance of parenting for child development. Although parenting has been shown to play an important role in the development of child effortful control and ADHD symptoms, associations between parenting behaviours and child effortful control are not likely to be wholly an environmental parent-to-child effect. Part of the association between parenting behaviours and child self-regulatory outcomes can be explained by shared genes and child-to-parent effects. Having said that, chapter 2 contained the first direction of effects analysis between a parenting behaviour (parent-to-child hostility) and child ADHD symptoms that has used a design able to separate environmental and genetic effects. The findings from this chapter highlight the
importance of the home environment for the development, or maintenance, of child psychopathology. Child self-regulatory outcomes seem likely, given previous evidence, to be dependent on a mixture of genetic and environmental factors. There is not just one route to psychopathologies, such as ADHD, as indicated by modest effect sizes seen by parent-to-child effects. Also, not all children who experience certain environments will be equally prone to certain developmental outcomes, as genetic makeup greatly influences how susceptible to environmental influence the child will be.

All three results chapters in this thesis, albeit to differing extents, have provided some evidence for the impact of child effortful control on later parenting behaviours. Chapters 3 and 4 indicated that not all parenting behaviours are influenced by this child attribute. Negative parenting behaviours, such as parent-to-child hostility, may be more commonly associated with poorer child effortful control than positive parenting behaviours are to either poorer or better child effortful control. Family processes can play off one another to maintain difficulties, as indicated by the finding in chapter 2 that child effortful control is associated with later parent-to-child hostility, which in turn is related to later child ADHD symptoms. Family interventions are required to disrupt this problematic cycle and improve both child and parent behaviours in order to have long-term effectiveness. Intervention efforts could benefit from recognising that children and parents have effects on one another, whilst focusing on how parents who might find parenting more challenging (i.e. have poor self-regulatory abilities themselves) can learn techniques to cope with challenging child attributes, such as poor effortful control. Interventions based outside of the home environment (e.g. in schools) could provide opportunities for children to develop self-regulatory skills, which would allow children with poorer effortful control starting school to catch up with their peers. Interventions
based inside the home environment should aim to improve both child and parent self-regulatory abilities, and cover topics such as parental self-care and self-compassion.

The research detailed in this thesis indicates that the nature of the relationship between child effortful control and parenting behaviours may change over time, meaning that it is important for researchers to consider different directions of effects and the impact of different covariates at different ages when drawing up analysis plans. It is also important for researchers to consider how best to operationalise both child and parent factors and what methodological choices mean for the implications of the findings. Chapter 3 showed that methodology choice played a major role in determining whether a ‘significant’ effect was found; questionnaire studies far more commonly find significant results than those using observation tasks or lab-tasks. This finding was further supported by the difference in results between chapters 2 and 4.

Given the importance of child effortful control for later developmental outcomes, both directly and indirectly via parenting, research exploring developmental pathways to effortful control is important. Overall, it seems that parents do play a role in the development of child effortful control, but part of this association between these parent and child attributes seems to be from child to parent, with child effortful control predicting later parenting behaviours. It is important that future research on this topic tests for direction of effects or at least takes previous child attributes into account when running models of child mental health and wellbeing development.
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